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This study was designed to develop a concept of creativity which is independent of demonstrated skill in a particular area and to develop a technique for indentifying and measuring creativity in line with this concept. Three hundred and sixty-eight subjects, mainly college students participated in the study. The relationships between the tendency to solve problems successfully or unsuccessfully and the tendency to demand much or little information were studied, as were the relationsips between these variables and both personality characteristics and external criteria of creativity.

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INFERENCE, GUESSWORK AND CREATIVITY

COOPERATIVE RESEARCH PROJECT #684

MALCOLM R. WESTCOTT

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INFERENCE, GUESSWORK AND CREATIVITY

Malcolm R. Westcott
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Poughkeepsie, New York

Project Number 684
October 1, 1959 - December 31, 1962

BACKGROUND. In spite of the rapid increase in interest and research in the area of creativity during recent years, relatively little attention has been paid to conceptual and theoretical problems. The research reported here was oriented toward the development of a conception of creativity which utilizes earlier theorizing on the problem which has arisen in various areas and which places the phenomenon of creativity in relation to other general psychological phenomena. It is further directed toward the exploration of investigatory techniques and empirically testable hypotheses which derive from such a view.

OBJECTIVES The research was conducted toward the following three classes of objectives:

1. Theoretical objectives: the development of a conceptualization of creativity which had the characteristics of a) being process oriented and task related; b) being stated in terms of general psychological principles; c) being translatable into operations and embodied in an experimental procedure.

2. Technical objectives: the development and exploration of a research technique based on such a conceptualization.

3. Empirical objectives: the collection of a basic body of knowledge concerning the correlates of various types of performance on derived experimental measures.

PROCEDURES AND RESULTS.1. The theoretical objectives were pursued through an analysis of the descriptions and discussions of creativity offered by psychologists, philosophers, mathematicians, poets and musicians. Within this heterogenous body of literature there appeared one line of reasoning which was primarily psychological and which was presented by different authors in somewhat different forms between 1898 and 1946. This line of reasoning considers creativity as a variation of "ordinary" thinking and involves the utilization of accumulated experience for the production of new combinations or correlates. The act of doing this is often obscure and thus gains an aura of mystery which calls for the special designation, "creativity."

Further study showed that this conceptualization of creativity, which placed it tangent to such areas of psychological research as learning and concept formation, was also closely related to the philosophical notion of intuition--the reaching of universally valid knowledge without the intervention of sensory or rational processes. Both concepts--creativity and intuition--appear to arise from the same observational base: the utilization of obscure or apparently absent information or processes for the production of unusually valuable ("creative") or universally valid ("intuited") conclusions. Neither of these conceptualizations is entirely tenable for research purposes since "unusual value" must be a subjective and variable judgment, and "universal validity" is not demonstrable. On the other hand, both conceptualizations share the view that the phenomena are marked by a notable gap between demonstrable information and final conclusion. The psychological analysis of creativity claims that obscure but normal psychological processes fill this gap, while the philosophical treatment of intuition typically, but not always, calls upon non-sensory and non-rational processes to bridge it.

These appeared to be two names and two different explanations given to the same observation--an observation that some individuals can and do reach

useful conclusions on the basis of very little information.

The drawbacks of the psychological view of creativity lie in the assessment of "particular value" and the drawbacks of the term "creativity" itself lie in its overuse. "Creativity" or "creative" currently is used to refer to almost any successful human endeavor, and even in well-controlled research, criteria shift from one researcher to another, and there is a body of research on the "criterion" problem itself. The drawbacks of the philosophical view of intuition lie primarily in the phenomenon being seen as contingent on non-sensory and non-rational processes, but the term "intuition" itself has the advantage of having a specific referrent. The term "intuition" was adopted to refer to the observed events, but the psychological analysis relying on normal processes was utilized as explanatory.

The derived concept does not include the requirement of "particular value" because of its subjectivity and in place of the "universal validity" of the philosophical analysis, consensual validity was required. The working concept to be studied then is "intuition," as the reaching of conclusions on the basis of little information which are ordinarily reached on the basis of significantly more information.

2. The operationalization of this concept is quite direct, and is implemented by providing experimental subjects with problems to solve and making relevant information available to them in small quantities. They may take as much or as little as they like before attempting a solution, and the success of the solution is assessed in terms of the original definition: the solution is correct if it agrees with the solution consensually reached on the basis of significantly more information.

Specifically, a set of problems was developed which consisted of four types: verbal series, numerical series, verbal analogies and numerical analogies. The series problems were simple presentations of a series, one step at a time, and the task was to complete the series after seeing as few

steps as possible. Each step in a series was called a "clue." The analogy problems were presented so that repeated examples of a relationship could be made available, and the task was to complete an analog to this relationship after seeing as few examples as possible. Each example of a relationship was called a "clue." The task was called intuitive problem solving.

3. Another method, suitable for use with children was also developed. Drawings from children's coloring books were fragmented so that a series of representations of the same object could be presented, each more complete than the one before it. They ranged from a few scattered lines to nearly complete pictures. The task was to identify the subject (e.g., a drum, a duck, a kite, etc.) as early in the series as possible. Six or seven series were presented as the laboratory procedure and the task was called Perceptual Inference.

4. The intuitive problem solving task was administered to eight samples of college students, numbering 363 subjects in all. The different samples yielded very similar group performances and in each sample, individual performances were distributed in approximately normal fashion.

Three scores were computed for each subject: a) a score for the amount of information required, being either a simple total of the number of clues taken on the task, or a transformation of this number weighted so that each clue received a value computed on the basis of the demand for clues on the particular problem to which it was relevant. These two scores were called Clue Use and Information Demand respectively; b) a score for the total number of correct solutions, which was called Success; c) a third score, called Efficiency, was determined as a ratio of output (Success) to input (Information Demand).

The distributions of the performances of the eight samples indicate that individuals do differ in both the amount of information they require before

reaching solutions to problems, and the success with which they reach these solutions. The scores which are obtained yield split-half reliabilities ranging from .36 to .72 for Success, from .73 to .91 for Information Demand, and from .61 to .86 for Efficiency. These reliabilities are sufficiently high to indicate that a relatively stable phenomenon is under consideration. It is of considerable interest to note that the taking of greater or lesser amounts of information is consistently unrelated to success in solving the problems. The correlations between Information Demand and Success range from -.20 to +.24, and in only one of eight samples does the correlation reach significance. This finding indicates that different individuals utilize the information which they take more or less efficiently. The most efficient problem solvers meet the definition of intuitive problem solving.

In addition to the subjects originally described as intuitive, this lack of correlation between Information Demand and Success provides three other groups of subjects which can be described on the same axes as the intuitive thinkers, but which represent quite different kinds of performance. In addition to 1) the intuitive thinkers--individuals who demand little information and attain high success, there are 2) those who require very little information and fail consistently--called wild guessers, 3) those who require a great deal of information and succeed in using it - careful successes, and finally 4) those who take excessive information and still fail - cautious failures. This finding requires the elaboration of the concept of intuition into two dimensions--the dimension represented by Information Demand, and the dimension represented by Success.

5. The Perceptual Inference task differentiated among subjects ranging from nursery school through college, and the principal score, called "mean right" and computed as the mean point in a set of fragmented drawing series at which correct inferences were made becomes lower (better) and less variable as age

and educational status increase. The split-half reliability of this score lies between .66 and .78 for 5th and 6th grade children, and the test-retest reliability using an alternate form for the retest, ranged from .40 to .68 for two samples over a two-year period. Since the experimentation with the Perceptual Inference task allowed the subjects to seek more information if their first inference was not correct, there is no evidence concerning independence of the success and information dimensions. It does appear, however, that a stable measurement relevant to a theoretical construct is being made.

6. Several varieties of correlational studies were carried out comparing performances of intuitive problem solving with performances on more standardized measurement procedures. The results, in general, showed only minimal relationships between intuitive problem solving and academic aptitude, academic success, or those personality dimensions studied. Specirically, the relationships between the Scholastic Aptitude Test Verbal score and the various intuitive problem solving scores were low, variable, and only occasionally significant, when computed on repeated samples. Between the SAT Mathematical score and intuitive problem solving scores, the correlations were low, but more consistent. There were negative relationships with Information Demand, positive relationships with Success, and significant positive relationships with Efficiency. Academic success, measured by cumulative grade averages was consistently uncorrelated with the intuitive problem solving scores.

7. The personality scale utilized was made up of two scales taken from the Vassar College Attitude Inventory (Impulse Expression and Flexibility) and the Taylor Manifest Anxiety Scale. The relationships between the intuitive problem solving scores and the three personality scales were low, variable, and only faint trends could be observed.

8. An item-analysis was performed on the personality scale using three samples of subjects who were extreme performers on the intuitive problem solving scale. Extreme performers were selected on the basis of being at least 1 S.D.

high or low on both dimensions--Information Demand and Success. The three samples contained 10 subjects who were low on Information Demand and high on Success, 17 who were low on Information Demand and low on Success, 22 who were high on Information Demand and high on Success, and 20 who were high on Information Demand and low on Success.

From the scale, 31 items were extracted which were useful in providing significant discrimination among the various groups. The clusters of items were both statistically significant and psychologically meaningful, and it appeared that the intuitive thinkers were primarily characterized by being ego-involved in their activities and comfortably unconventional; the wild guessers were notable as being anxiously unconventional and self-absorbed; the careful successes were conservative, compliant and comfortable; the cautious failures were fearful, defensive and moralistic.

9. A more detailed exploration of these extreme performers was carried out through individual interviews and an adjective check list study with two samples. The interviews were oriented around six quite general questions ranging from the subjects' reactions to the intuitive problem solving task to their consuming passions. There were, for example, differences in the groups' reactions to the test situation: of the intuitive thinkers, 86 per cent were enthusiastic, the rest neutral; of the cautious failures, 50 per cent were actively negative, only 14 per cent positive, and the rest neutral. There were differences in the proportions of the various groups professing interest in different areas: there were more of the intuitive thinkers interested in music and reading (71 per cent) than of any of the other groups; there were fewer of the wild guessers (23 per cent) interested in people than of any other group; there were more of the careful successes interested in art (64 per cent) than of any other group. In all areas of interest uncovered, the extent to which the various groups participated "creatively" was sought: there was more participation

in the group of intuitive thinkers (86 per cent) than in any other group, and less in the group of wild guessers (33 per cent) than in the other groups.

It was of interest to note that the most effective problem solvers and the least effective problem solvers--the intuitive thinkers and the cautious failures--both reported a fairly high incidence of significant change in their lives (56 and 57 per cent respectively), while the other two groups report this less than 25 per cent of the time. One of the areas in which the greatest differentiation was noted was the different groups' attitudes toward risk. The intuitive thinkers were 100 per cent in favor of taking risks and appeared to enjoy the contemplation of risk; the wild guessers were 62 per cent in favor of risk, but did not appear to feel so comfortable with it; the careful successes showed more dislike than liking for risky enterprises; and of the cautious failures fully half were unable to make up their minds as to whether they liked or disliked risk. As a final example, the groups are differentiated by the extent to which they are aware of being influenced in any significant way by other individuals. The intuitive thinkers are very aware of influence from outside themselves (70 per cent), while the careful successes--those who are most successfully socialized, report significant influence the least frequently (14 per cent).

10. The adjective check list study revealed some additional ways in which these four groups may be distinguished. Their self-concepts share certain elements, but there are distinct features as well. The intuitive thinkers see themselves as being "alert," "quick," "confident," "informal," "spontaneous" and "independent"; the wild guessers, who share the low Information Demand scores with the preceding group, also share self description as "alert," and "quick", but add to these the features of being "cynical" and "headstrong." They also identify themselves as "conscientious" significantly less often than do all other groups. The careful successes see themselves as being "cautious," "kind," "modest," and share "confident," "informal," and "spontaneous" with the other successful group--the intuitive thinkers. On the other hand, they share with the cautious failures the descriptive terms, "cautious," "modest," "kind." The members of this fourth

group, the cautious failures, describe themselves as "self-confident" significantly less often than any of the other groups, and never identify themselves as "demanding," "sharpwitted,""cynical" or headstrong."

CONCLUSIONS AND IMPLICATIONS. 1. A conceptualization of intuition is offered which taps both psychological and philosophical theorizing. It is a process conception which focusses its concern on what an individual is doing when he is solving problems intuitively. It describes, but does not yet analyze.

2. Methods for investigating the act of intuitive problem solving have been derived from this conceptualization and have been demonstrated to differentiate stably among subjects at a variety of age levels.

3. Intuitive problem solving ability as defined and measured is not strongly related to several conventional measures of intellectual prowess normally utilized in academic settings; nor is it related to certain standardized personality measures.

4. Clusters of personality scale items which are both statistically significant and psychologically meaningful have been identified which differentiate individuals who display different varieties of intuitive problem solving behavior.

5. Differences among extreme performers on an intuitive problem solving task are revealed by interview techniques, and the differences are in accord with the personality scale items.

6. Groups of extreme performers are distinguished by their self-descriptions on an adjective check list, again, in accord with the personality scale items and the interview materials.

7. Clusters of psychological data, including intuitive problem solving performance, personality scale items, interview materials, and self descriptions, characterize four groups of individuals who appear very different in their approaches to and successes in ~~they~~ many spheres of activity. These differences, which are in accord with descriptions of intuitive activity are not reflected in usual measures of their college experience or performance.

8. It is suggested that quite different intellectual experiences are required for the full development of the talents of each extreme group and that the search for and identification of unusual and desirable talent is of little use unless individualistic educational experiences are available to meet the needs of different individuals.

BIBLIOGRAPHY. There are 28 references in the final report.

IIFERENCE, GUESSWORK AND CREATIVITY

Cooperative Research Project No. 684

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Poughkeepsie, New York

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The Problem

The focus of this research is three fold. It is concerned with 1) the development of a conception of creativity which had specific characteristics; 2) it is concerned with the development of a method for empirical investigation of creativity which is theoretically based, and 3) it is concerned with the establishment of a rudimentary body of knowledge based on an explicit theoretical position and a specific measurement technique. The specific objectives of the research fall into three categories consonant with the three facets of the problem: 1) theoretical objectives, concerned with the conceptualization and appropriate placement of creativity within the body of psychology; 2) technical objectives, concerned with problems of measurement and experimentation; 3) empirical objectives, concerned with the establishment of new facts. The major problems and achievements in each area will be detailed below. Most of them have been published, or are in press at the time of this report.

Related Research

The general research in the area of creativity is much to extensive to be reviewed here, and the impetus for the present work has arisen from a quite specific segment of this research only. It seems appropriate to offer some review of that particularly relevant material and make no pretense of offering an introduction to the general literature on the subject.

The literature which is of particular interest to the present work arises primarily prior to 1950. Until that time there had been little general interest in the study of creativity, if one can judge from Hutchinson's (1931) report that essentially nothing was known about the phenomenon in spite of sporadic research since before the turn of the century. A similar report was offered a good bit later by Guilford (1950) who indicated that of a total of 121,000 entries in the Psychological Abstracts for a period of 23 years, only 183 referred to creativity, and almost none of these were empirical or experimental studies. During this period before 1950, most of the efforts in this area were philosophical, theoretical or purely speculative, and it is to some of these works, bolstered by some few elements of empirical support, that the present author owes his greatest debt. Since 1950, while the body of material on creativity has grown at a steadily increasing rate, the growth has been almost entirely on the empirical front, with more and more full descriptions being offered of the creative product and of the creative person, and more and more efforts made to identify individuals with unusual talent, often called "creative". The bulk of this work has little to do with creativity as a theoretical issue, and while the phenomenon is implicitly assumed to lie within the framework of psychology, its status remains hazy, and its locus, ill-defined.

The early theoretical efforts can best be introduced by reference to a number of particularly influential works. One of the first of these (Royce, 1898) located creativity in a fairly commonplace setting. His observations and experiments had convinced him that creativity simply represented particularly significant or useful variations of habits already in his subjects' repertoire, and that such variations are facilitated or inhibited by the social conditions immediately surrounding the subject. His data support this conclusion, but they are limited, and there is no evidence that they were ever followed up. It was not until more than 25 years later that another striking work appeared. Wallas's book (1926) is still referred to frequently, and represents an analysis of thinking into four stages--with guides for increasing the efficiency of one's thinking processes. Wallas indicated that thinking could be broken into the stages of 1) preparation, 2) incubation, 3) illumination, and 4) verification. He claimed that this applied to all thought, and creativity represented a special case of these processes in which the preparation was carried on, often informally, over a fairly long period of time, the incubation was long and obscure, the illumination was particularly sudden, and the verification nearly automatic. He reasoned

that these special characteristics demanded a special status for "creative thinking", but that it was qualitatively no different from "ordinary" thinking. Examples of creative thinking were analyzed in these terms, but no experimentation based on this conceptualization was carried out.

A few years later, Spearman (1931) presented another analysis of creative thinking in terms which were also applicable to everyday thinking, and he described three governing principles: 1) the apprehension of experience, that is, individuals can be aware of their own experience; 2) the perception of relations, that is, relationships among the parts of experience can be perceived; 3) the eduction of correlates, that is, an individual who apprehends experience and perceives relations can generate a correlate to that relationship. These three principles were used to explain the fact that individuals could take a few examples of a problem or of a solution to a problem, comprehend the relationships involved, and then go on to utilize such abstracted relationships in a new context. He reported the results of several experiments based on these principles, in which the environment was controlled so that repeated examples of a principle were given, and then subjects were asked to apply the principle which they had perceived, in a new situation. Here, creativity was seen as the eduction of particularly novel or successfull correlates. Unfortunately, the experiments were not very successful, and the subjects did rather poorly in carrying out in the experimental situation, activities which they apparently carry out quite successfully in everyday life. The outcome of the experiments is of less importance that is the fact that the process of controlling information given to subjects and then requiring them to utilize this controlled information was established as an investigatory method.

An example of another line of experiments bearing on this problem, although not so obviously related, was carried out by Pickford in 1938. He did what is now called a study of unconscious concept formation, and showed that subjects display significant improvement in performance in a sorting task prior to the point of "insight". He analyzed the results in terms of the principle that individuals can and do acquire and utilize concepts in solving problems before they have awareness of the concept or the fact that they are using a concept. The general literature on unconscious concept formation and behavior without awareness has been recently reviewed by Adams (1957) in its own right, but only rarely are the phenomena interpreted as relevant to the explanation of some of the more spectacular forms of problem solving, e.g. "creativity."

Another experiment, by Higgins (1944) was very nearly a study of thinking modeled after the Spearman principles. He studied the ways in which school children interpreted the results of simple biological experiments, and what they inferred from them. He was, unfortunately for our purposes, interested in the varieties of error more than in the varieties of success, and consequently this experiment gives us little information about the ways in which unusual success or "creativity" operate. It is clear, however, that again the method originally offered

by Spearman is utilized: the giving of information and the requirement that it be used to generate new hypotheses.

A similar approach was offered by Welch (1946). He gave relatively meaningless materials to subjects, in the form of scrambled letters, scrambled words, and assorted wooden blocks, with the requirement that these elements be combined into meaningful structures such as words, sentences, stories, household articles, etc. His results showed that architects and designers did better on the structural materials and the college students did better on the verbal materials, which may only demonstrate the effects of familiarity with materials. He did, however, use the method of providing unordered material, with the requirement that it be brought into comprehensibility. He referred to his study as a study of "creativity".

For the most part, subsequent to 1950, research in this area has been empirical, and the effort has been to identify individuals who are "creative" without direct reference to a firm conceptualization of creativity. There have been some recent attempts to analyze creative thinking in terms of well-established principles of psychology, but they have been few and far between. The most successful of these is by Mednick (1962) who treats creative thinking in terms of an associationistic model, and supports his interpretation with strong data. From a wide variety of sources descriptions of creativity, studies of antecedents of creativity, and discussions of the creative person have poured in, so that there is an ever elaborating picture of the phenomenon, in a variety of terms. There remains, however, a paucity of theorizing which is based on general psychological theory and which adequately locates creativity within the field of psychology. One particularly good source of references on the many facets of the subject is the combined bibliographies of the reports of the University of Utah Research Conferences on the Identification of Creative Scientific Talent (Taylor, 1955, 1957, 1959, 1962 in press) which list well over 500 titles.

These, then, are the principal research and theoretical attempts which provide the background for the present conceptualization and experimentation. The relevance of these background materials will be evident in the sections which follow. We return now to a more detailed formulation of the objectives and the findings of this project which bear on them.

Theoretical Objectives[1]

The theoretical objectives, as stated earlier involve the development of a conceptualization of creativity which has specific characteristics. These specific characteristics are: 1) it must be a process conception, and task-related, that is, it must refer to what a person is doing when he is being "creative"; 2) it must be a conception which is firmly related to the existing body of psychological knowledge, that is, it must utilize psychological principles and introduce new ones only if their relation to existing ones can be made clear; 3) it must be a conception which lends itself to operational translation and consequent experimental investigation.

The author's earlier work (Westcott, 1955) embodied such a view of creativity and was based, at least in part, on the theoretical work cited in the preceding section. The subsequent development of the conceptualization led to somewhat different views and to a change in the primary terms employed.

The basic observation which is central to the concept with which this research is concerned is that some individuals reach sound and productive conclusions on the basis of what appears to be less information than others require for reaching the same conclusion. This is a relatively common observation, although its stability as a phenomenon had not been demonstrated prior to this research (Westcott, 1961).

Individuals who do reach firm and successful conclusions quickly are called "sharp", they are described as having "a steel trap mind", or as being "good guessers", etc. It appeared that the ability to operate in this way, however complex it may be, may be crucial in carrying out the activities which come to be called "creative", since individuals called "creative" carry out activities which other individuals cannot; they reach formulations which are not only consistent with known facts, but also with facts yet to be discovered; they leap beyond the obvious to new views of reality and can then demonstrate either logically or empirically that this new view is in accord with known facts and predicts new ones. These speculations led to the conclusion that individuals who are said to be "creative" may well be carrying on a special variety of inference--inference which bridges a great gap rather than a small one, and reaches a conclusion which does not obviously follow from the information, but which subsequently can be demonstrated to be appropriate, adequate, suitable and sound. Because the conclusion reached in this inferential act does not necessarily follow from the data as presently available, and because it turns out to be a useful or sound one, observers are able to identify the act as being of particular consequence. It is

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[1] Much of this material is included in another paper. (Westcott, 1962)

thus called "novel", "original" or "creative", and the person who accomplishes this act is similarly identified.

Thus, the process of what we call "creativity" is seen as a special variety of inference which attains its special status because of the strikingly large gap between information and conclusion, and because of the consequent originality of the product--whether it be a tangible product or a conceptual one. This conceptualization is clearly in accord with both Wallas and Spearman.

The question naturally arises as to how this behavior differs from "good guessing", if indeed, it differs at all. The differences appear to rest primarily on 1) the value judgements applied to the product or conclusion reached, and 2) the consistency of the behavior. Products or conclusions which are "creative" must be more than simply "original"--they must be of particular value to at least some observers. In addition, an individual is not given this title of "creative" on the basis of a single act--he must carry out this activity with some consistency. Thus the restraint of "consistency" was placed on the conceptualization, although the restraint of "value" was not, since it requires an entirely subjective judgment: an individual must make long inferences repeatedly in order to fit the notion of "creative".

So far the conceptualization meets the requirement of being a "process" notion, it is task related, and it resides well within the limits of psychological knowledge, sharing boundaries with studies of concept formation, thinking, generalization, and the entire field of learning. It does not, however, share much with other contemporary notions of "creativity".

The great bulk of contemporary conceptualizations or definitions offered for the purpose of specific experiments are focussed on "products"--it is the product which is first evaluated as "creative", not the process by which the product is achieved. The process becomes so identified only if "creative" products are consistently generated by the same individual. Then his processes (often otherwise undescribed) are called "creative" processes. It must be noted that psychological conceptions of "creativity" are by no means all product conceptions, nor is the process view presented here the only one offered. Other process notions have been suggested, but concern themselves principally with conceptualizing thought as information processing. They yield experiments with computer simulation of thought rather than with human subjects solving problems (cf. Taylor, 1960). These various kinds of conceptualizations do not overlap--nor do they contradict.

A continuing survey of recent alternative conceptualizations, for purposes of comparison, revealed that "creativity", as a term referring to a particular identifiable phenomenon, had lost its usefulness by losing any specificity of referrent. The term had come to refer (both within and outside psychology) to any intellectual or artistic or political

or economic or mechanical performance or product which was particularly successful or out of the ordinary. Indeed, Taylor (1960) indicated that the most successful single method for identifying "creative" individuals is to ask colleagues to rate each other on "creativity", using whatever criteria they choose, and then utilize this vote method for finding one's subjects. Not only is theory avoided, but specific definition is avoided as well. As mentioned earlier, there have been some thorough theoretical attempts recently (cf. Mednick, 1962) but this type of analysis has not proceeded on a very wide front.

With this profound diffuseness of "creativity" in mind, it seemed that the phenomenon which was to be explored in this research was sufficiently specific that it was not helpful or productive to call it "creativity" any longer. Consequently, a body of writing which fell within the wider literature on "creativity" was analyzed for its relevance. It emerged that the phenomenon with which the present research was concerned was best represented in the philosophical literature as "intuition". Indeed many of the views of "intuition" which have been summarized by Wild (1938) are concerned with precisely the kind of phenomena with which Spearman (1931) was concerned, with which Pickford (1938) was concerned, with which Wallas (1926) was concerned, and with which the present research is concerned.

Intuition has been discussed by a wide variety of writers--philosophers, artists, mathematicians, musicians, but almost not at all by psychologists. While there are many uses to which the term "intuition" has been put, it is not as varied or as vague in its usage as is "creative", and one of the most common referrents is precisely the process described as the central phenomenon of concern to this research--the long inference, that is, the reaching conclusions which do not obviously follow from the evidence, conclusions which often do not, in fact, have any obvious supportive evidence at all. The great bulk of analyses of this phenomenon are provided by philosophers and call upon non-sensory processes or "abnormal ways of knowing" as explanatory (Wild, 1938).

Descriptions of the phenomenon of intuition have a great deal in common, and are usually based on a few spectacular examples of the "Aha!" or "Eureka!" variety. There was no question that this was the phenomenon with which the author had been concerned in psychological terms, but with several differences. To the philosophers, intuition was an all-or-non phenomenon; intuition did not share features with everyday thinking or problem solving; intuition did not call upon normal psychological processes; intuition was represented only in its extreme form. To the present author these features seemed to preclude the inclusion of such conceptualizations into general psychology, but the phenomenon was obviously of interest to psychology. Thus, the phenomenon of intuition remained, but was considered as one which occurred at all levels of sophistication and complexity, the extreme of which was the "Eureka" of the philosophers.

Maintaining the gross description of intuition, but applying a further analysis to it, the conceptualization emerged that intuition was the name given to the act of reaching conclusions on the basis of little information which would ordinarily be reached on the basis of significantly more information. This then could be offered as a phenomenon hypothesized to be distributed through any population, and which could be studied at any level of sophistication or complexity.

Thus we have a process concept, it is related to the task, it is related to the existing body of psychological knowledge, in that it has roots in specific psychological theory and it shares boundaries with the psychology of thinking and inference, generalization and concept formation, and it is (as will be demonstrated subsequently) amenable to operationalization and experimentation.

From this notion of intuition, one may hypothesize that if a sample of subjects is given problems to solve, and if relevant information is provided in small quantities, some individuals will require more information before they attempt a solution than others will. If the subjects are encouraged to strive for adequacy of solutions and at the same time to use as little information as possible, the differences among them will stand out clearly. It may also be hypothesized that any differences observed will be stable differences, and will have implications for the ways in which individuals respond to problem solving situations outside the laboratory setting.

These hypotheses concern both the measurement of intuition and the consequence of intuition. The exploration of these hypotheses is the aim of the next two sections.

Thus, from a study of the literature on creativity, it became evident that several conceptualizations have been suggested which are in accord with the phenomenon which is the central focus of this research. At the same time it became evident that the specificity of the term "creativity" or "creative thinking" has been so reduced that the use of a term which referred more stably to the phenomenon of interest should be sought. Such a stable usage was found in the literature on intuition, and the use of this term is adopted to refer to the process of reaching conclusions on the basis of little information which are normally reached on the basis of significantly more information.

Technical Objectives

The technical objectives are concerned with a method for investigating the above conceptualization of intuition. Specifically, the task was to develop a technique by which problems could be presented to subjects, and relevant information made available in small measurable amounts so that subjects could take as much or as little information as they desired in attempting to solve the problems. It was considered important that the problems be essentially "content-free", that is, not require any specialized knowledge, and that they have clear solutions which could be evaluated as correct or incorrect. A set of such problems could provide the researcher with a measure of how successfully a subject reaches conclusions, and whether the conclusions are reached on the basis of little or much information. The identification of individuals who meet the above definition of "intuitive" would be a simple task, and such individuals could be studied further.

The method selected,[2] and the types of problems utilized have been described by the author in earlier papers (Westcott, 1960, 1961) and are as follows. The problems are of four types: verbal series problems, verbal analogy problems, numerical series problems, numerical analogy problems. These four types are content free, in that they require no special linguistic or mathematical skills beyond what can reasonably be expected of the college students used as subjects. The series problems are constructed so that a verbal or numerical progression is presented in a series of steps, and the subject is to complete the series after seeing as few or as many of the steps as desired. The analogy problems are constructed so that repeated examples of a relationship are given, and the subject is to complete an analog to that relationship after seeing as few or as many examples as desired. Each step in a series, or each example in an analogy problem is called a "clue". The actual mechanics of presentation were as follows: Long slots were cut in a filing folder, and behind these slots strips of paper were attached so that in a given slot appeared all the available clues for one problem. The clues for series problems were in sequential order, but there was no sequential binding for the analogy problems. Over each slot was attached a long paper tab, and the tab was fastened down over each clue with a paper seal. As a subject wanted a clue, he lifted the tab, broke the seal, and read it; if he wanted another, he lifted the tab further and broke another seal, etc., until he either had enough information or had exhausted the supply of clues. On a separate sheet of paper the subject was to enter the proper completion to the series or the proper completion of an analog.

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[2] A set of instructions, problems, solutions and formats for presentation appear as Figs. 1, 2, and 3 in the Appendix.

After considerable experimentation with these mechanics, a new method was developed which increased efficiency by a considerable factor. One of the most time-consuming aspects of the data gathering was the problem of replacing the broken seals after a group of subjects had worked the problems, so that the forms could be used for another group. This problem was solved by constructing the problem sheets from two pieces of masonite, hinged together like a book, with teflon tape. The two pieces of masonite were drilled with twenty rows of five slots each. A sheet of aluminum foil was placed between the sheets of masonite and a stylus could be pushed through any slot to punch out the foil without disturbing the foil in any other slot. Beneath this device for holding the foil, a sheet of clear vinyl was placed, and beneath that, a sheet of paper containing rows of clues which matched the rows of slots. All this was fastened together, and it was then possible for a subject to punch out a foil seal and see a clue, without making any other clue available to him. The punched foil provided a permanent record of the subject's information requirements, and the simple operation of opening the masonite "book" and replacing the sheet of foil made the device available for further use.

The problems themselves were selected in a purely empirical manner. Numerical and verbal series of varying length were designed by the author with only one restriction: when all the clues were used, there must be only one appropriate completion. Similarly, from both verbal and numerical materials, repeated examples of a relationship were constructed, and an incomplete analog to that relationship was provided for the subject to complete. These problems, twenty in number, were then placed in the device and presented to subjects. It became clear very quickly that some items did not discriminate among subjects and that some of the items had, in fact, more than one right answer, and these items were replaced. Some items had excessive clues, which were never used by subjects, and some needed more clues to allow greater differentiation among subjects. Each of these defects was readily remedied, and a set of items was prepared for experimental use. While there were some changes made in the overall set of items as the research progressed, these were minor, and as is indicated later, there are no important differences in group performances from form to form.

Evaluation of a subject's performance on a set of such problems is based on two scores. The measurement of the amount of information an individual requires before attempting solutions to problems can be a simple count of the number of clues taken on the entire set of problems. Such a count is indicated in this report as ΣC and called Clue Use. An alternative method is to weight the value of the clues on each item as a function of the mean and SD of clue use on that item. With raw Clue Use scores for each item transformed to standard scores, we have the score designated as Cz, and summed over items, is ΣCz. This is called Information Demand. While these two scores are highly correlated, it is felt that the latter is more satisfactory since it

provides a weighting for clues which is a reflection of the extent to which clues are required for a particular item.

The simple count of the number of correct solutions gives a score designated as ΣR and called Success. This score requires some explanation. A "correct" solution is that solution which is reached when all the information is used. For every item, there is high concensual validity for the "correct" solution, in spite of the fact that alternative "incorrect" solutions are consistent with the information when only a small amount has been taken. The scoring of the concensual solution as the "correct" one is strictly in accord with the guiding definition offered above--reaching conclusions on the basis of little information which are normally reached on the basis of significantly more information. The conclusion which is reached with high accord on the basis of much information is the "correct" solution. The 2 scores, Information Demand and Success, can be combined into a ratio of output to input $(\Sigma R/\Sigma C_z)$ and a score Efficiency calculated.

In all, eight samples of subjects have been given the problems, and they constitute the pool from which sub-samples are drawn for the various data analyses. They are as follows, and they will be referred to by their abbreviated designations throughout the remainder of this report: 30 undergraduates and graduate students at Oxford University, originally studied in 1955 in connection with the author's earlier work on problems of this type (Oxf55); 33 Vassar College seniors studied in 1959 (VCSr59); 70 Vassar Freshmen drawn randomly as a sample in 1960 and studied continuously since that time (VCFr60A); a parallel sample of 70 Vassar Freshmen drawn from the same population at the same time (VCFr60B); 44 Vassar Seniors drawn randomly as a sample in 1960 (VCSr60); 55 Vassar Seniors drawn randomly in 1961 (VCSr61); 28 females from Bard College, all volunteers and from different classes, studied in 1961 (BF61); 38 males from Bard College, all volunteers and from different classes, studied in 1961 (BM61). A total of 368 subjects are included. The characteristics of the 8 samples appear in Table 1.

The first hypotheses to be tested concern the measurability and stability of the phenomenon of intuition. Specifically, these hypotheses were that individuals would differ in their performances on the experimental task and that the differences among individuals would be stable. The appropriate data to bring to bear on these hypotheses are the data concerning the distributions of individual performances and data concerning reliability of measurement.

In addition to the basic measurements described earlier, the time taken by each subject to complete the task was recorded for some samples, and a rating of confidence was also requested as each subject completed each problem. Confidence in each solution was rated on the following scale: 1) wild guess; 2) unsure; 3) fairly confident; 4) certain. No use has yet been made of the time measurements, and only very limited

use of the confidence measures.

The raw performance data for the separate samples appear in Table 2. Of the 20 problems, the mean number solved correctly by the different groups ranges from 13.1 to 16.0, with SDs varying from 1.9 to 2.7. The mean number of clues taken (from pools of different sizes as indicated) vary from 49.0 to 58.4. The SDs of ΣC lie between 6.8 and 10.9. The mean time taken to complete the problems ranges from 33.3 min. to 46.1 min. and the SDs if these times are from 11.0 to 14.1. The mean total confidence reported by the different groups from which this rating was requested lies between 60.4 and 68.4 with SDs between 6.1 and 8.7. It is evident that the number of problems solved correctly and the number of clues taken prior to an attempted solution, the time taken, and the overall confidence reported vary from person to person, and that the eight samples are quite similar in the average levels of performance and in the variabilities they display on these measures. It appears that there is differentiation among individuals within each group, and different groups are distributed in similar ways.

Split-half reliabilities of the separate scores for the separate samples appear in Table 3. Success, Information Demand and Efficiency are presented separately, and the measures of reliability for Success vary from .36 to .72, the reliability of Information Demand lies between .73 and .91, and the Efficiency score is reliable within the limits of .61 to .86.

Additional studies of internal consistency of measurement were carried out by the computation of various part-scores. Part-scores based on 10 series items were correlated with part-scores based on 10 analogy items for 6 samples, and these correlations range from .27 to .52 for ΣR, from .44 to .70 for ΣC, and from .44 to .68 for ΣCz (cf. Table 4). These reliabilities across item types are somewhat lower than the reliabilities determined by the direct split-half method, inasmuch as they are based on 10-item part scores, and are not corrected for reduced length. With one exception they are significant beyond the .05 level.

Items were then ordered in difficulty, and part-scores based on two halves of the scale, balanced for difficulty were computed. "Difficulty" was determined simply by the number of correct solutions which were given to each problem, regardless of the number of clues on which the solutions were based. The problem with the greatest number of successes was ranked first, and so on to the problem on which the smallest number of successes was attained. This reliability determination was carried out on only one sample, (VCFr60A) since it was found to be well within the range of the other reliability measures. Because the split was not across item types, and was balanced, the Spearman-Brown formula was applied. On a difficulty split, then, the estimated reliabilities of the three principal measures are: for ΣR,

.62; for ΣC, .80, for ΣCz, .74, for $\Sigma R/\Sigma Cz$, .56. For different samples, the difficulty of items shifted slightly, on the basis of a slightly higher or lower frequency of success, but these changes were minor, and amounted to only one or two places in the rank order. Rank order correlations between 3 estimates of difficulty on 3 samples (VCFr60A, VCFr60B, VCSr61) were .98, .95, .96.

One additional analysis aimed at the assessment of stability compared part-scores obtained on the verbal items and a part-score obtained on the numerical items. Any conclusions derived from this study must be mitigated by the fact that the two part-scores are based on unequal numbers of items, and the fact that the numerical items represent a very short subscale. There were 12 items which could clearly be identified as verbal, and 6 which were clearly numerical. The remaining 2 were mixed numerical and verbal, and were not included in the computation of part-scores. The reliability of measurement based on 6 numerical items and on 12 verbal items is as follows, for the one sample studied (VCFr 60A): for ΣR, .27; for ΣCz, .51; for $\Sigma R/\Sigma Cz$, .27 (cf. Table 6). These, while also lower than the split-half reliabilities, are necessarily attenuated due to the narrow range of the numerical part-score, and are not corrected by the Spearman-Brown formula. They are all significant beyond the .05 level.

Thus, we find that the conceptualization of intuition offered earlier does lend itself to operationalization and the phenomenon described conceptually can be studied by laboratory procedures. Individuals do vary in their tendencies to carry out intuitive thinking, and they are stable in these tendencies.

Certain basic findings presented above have not been commented upon yet since they do not bear directly on the hypotheses offered, but they deserve mention as being of considerable interest and importance. One of the most striking findings in this initial presentation, is the fact that the two principal scores, Information Demand, and Success, are consistently uncorrelated. The correlations range from -.20 to +.24 and in only one of 8 samples does the correlation reach the .05 level of significance. These correlations appear in Table 7.

This finding lends weight to the assertion that intuition is an identifiable capacity or tendency since it is evident that the amount of information taken on the entire scale by any individual does not predict his success in solving the problems. On the other hand, it does not indicate that the clues are irrelevant to the solution of problems. Cumulative plots of successes on any problem against increasing clue use on that problem show that for a group, the exposure of each successive clue allows some additional subjects to reach successful solutions. Rather, it indicates that the effectiveness with which individuals use the information they gather varies, and individuals may gather much or little information, and show success to a degree essentially un-

related to the amount of information they have gathered.

This finding demands the elaboration of the concept of intution stated earlier, and requires that we offer a concept altered to the extent that it has two clear dimensions, which were actually implicit in the original formulation: the dimension of Information Demand, and the dimension of Success. Our study reveals four extreme positions on this pair of axes, each of which is represented by individual performances on the problem scale: 1) individuals who demand little information and reach a high degree of success--true intuitive thinkers, by definition; 2) individuals who demand little information, and consistently fail--wild guessers who are not part of our original conceptualization, but who can clearly be described and placed on the same dimensions; 3) individuals who demand excessive information and reach consistently sound conclusions--the cautious, successful problem solvers; 4) individuals who demand excessive information and still consistently fail to reach sound conclusions--the cautious failures. Only the first type of performance was indicated as part of the concept of intuition, but the other three types can clearly be placed on the same framework, and demand our attention. Thus, the full concept is spread out as a two-dimensional one, which encompasses several varieties of behavior which were not originally expected.

The two additional findings indicated in Table 2 concerning time and confidence, have played little role so far in our thinking. It is evident that individuals differ in the amount of time they give to the task, since it was not a "timed" test, and in the confidence with which they solve the problems set for them. The time variable has simply been calculated, and otherwise ignored, while the confidence variable has been related to the separate scores gained on the problem scale. Table 8 shows the correlations of confidence with Success, Information Demand, and Efficiency. The correlations between confidence and Success are all positive, range from .29 to .73 and are all significant beyond the .05 level; between confidence and Information Demand, they are all negative, between -.17 and -.28, and only one is significant at the .05 level; between confidence and Efficiency, again they are all positive, between .38 and .68, and all significant at the .01 level. Confidence is clearly related to success and efficiency in solving problems and a strong hint of a relationship is indicated between confidence and the tendency to demand little information.

The conception of intuition with which we have so far been concerned is sufficiently broad to describe a process which can be measured at any level of sophistication or complexity. In addition to the problem scale the conception was further elaborated through a series of studies aimed at measuring the same processes in children.

A technique was developed for use with children which presented materials which became more and more complete in steps(as did the series

problems for the adults). The task given the children was almost identical to that given the adults: to identify the content of a body of material after seeing as few of its elements as possible. Specifically, the children were shown several sets of line drawings of familiar objects. The drawings were taken from coloring books and each set consisted of a series of more and more full representations of the object, graded over six or seven steps from a few scattered lines to an almost complete picture of that object. The objects represented were a locomotive, a duck, a kite, etc. Three separate forms were used, each giving similar results. An example appears as Fig. 4 in the Appendix.

It is assumed that the processes utilized in identifying the object as early in the series of drawings as possible were essentially the same as the processes utilized in solving problems on the basis of as little information as possible.

Three of the author's students carried out these studies as independent work either in connection with undergraduate theses or in connection with the MA work. The first two studies were exploratory, attempting to establish the possibility of differentiating children in a stable way on the dimensions discovered in the adult task of intuitive thinking. The task for the children was called "Perceptual Inference" and was described in its early stages by the author in another paper (Westcott, 1960). The first study (Decker, 1960) considered two samples of combined 5th and 6th grade students, and on these samples it was determined that individuals did in fact differ on the principal score used: the "mean right" score, calculated as the mean point in the series where a correct inference was made. The characteristics of performance for these samples appear in Table 9. The "mean right" score varied from 1.37 to 5.60, with an overall mean of 3.65 and a SD of .99. The separate scores, cognate with Information Demand and Success, are not available since the subjects were allowed to seek more information if their first inference was not correct.

This measure, "mean right" is highly related to IQ measurements for one sample, but not for the other. A low "mean right" score indicates a tendency toward long, successful inferences, and the correlations between Full Scale WISC IQ and "mean right" for one of Decker's groups was -.68; between the IQ determined from various group-administered intelligence tests for the other group and "mean right" was -.18. These data appear in Table 10.

The second study was very much the same, and was basically an attempt to replicate these findings. Leopold (1962) used an alternative form of the fragmented pictures and found similar performances on similar samples. For her set of pictures, the "mean right" score varied from 4.0 to 6.38, with a mean of 5.64 and a SD of .54 (cf. Table 9). The reliability of this measurement, based on a split-half determination, was .66 as compared to .78 in Decker's study. In this second

study, the correlation between IQ and "mean right" was -.16 (cf. Table 10). The IQ determinations were on the basis of a variety of tests, ranging from the Binet to the California Mental Maturity Scale.

Since it was determined that this procedure yielded performances in children which differentiated them in a stable way, it was decided to explore the limits over which this Perceptual Inference task might be useful for differentiating subjects. Accordingly, Gorny (1962) developed yet another set of pictures, based on the same procedure of fragmenting drawings from coloring books, and tested relatively small groups at four different academic levels. Her data appear in Table 11 and indicate that discrimination is possible at levels varying from nursery school to college, and that the "mean right" score becomes lower and less variable as the age and academic level increases. It is interesting to note that there is a great deal of overlap from group to group, and even between the extreme groups, one nursery school child did better than one college student.

There is one further finding to be mentioned. We have a follow-up study on Perceptual Inference among school children over a two-year period (Leopold, 1962). In Table 12 are the test-retest reliabilities for two samples, studied originally in 5th and 6th grades, and retested in the 7th and 8th grades with an alternate form. The reliabilities for the "mean right" score on the two samples are .40 and .68. There is some evidence then for stability over time in the Perceptual Inference task. A test-retest study of the intuitive problem solving scale is in progress at the time of this report.

It is indicated that an alternative method of measuring intuitive thinking can be derived from the conceptualization offered. We have described a method which is useful in discriminating young children in what appears to be a stable way, and additional study of this method is planned.

The exploration of these measurement techniques has been gratifying, and has already contributed a valuable elaboration of the concept from which they grew. In fact, this elaboration of the concept of intuition as a two-dimensional process has been strongly influential in guiding the empirical study which is the concern of the next section.

Empirical Objectives[3]

The empirical objectives may be divided into two major classes: prediction and description. The former class is concerned with the relatively specific prediction of performance in one or another area, based on an individual's performance on the intuitive problem solving task. The latter is concerned with the relatively hypothesis-free exploration of the characteristics of intuitive thinkers by whatever means and in whatever areas appear productive. Efforts in both areas were made, and the most promising of these were followed up in more detail.

It was evident at the outset of the predictive studies that a "criterion" problem was present. Efforts could be made to relate intuitive problem solving performance to both specific and to relatively non-specific external performances. Since the original orientation of the research and the original theoretical efforts were toward a conceptualization of "creativity", this was presumably one of the external criteria toward which predictions would be made.

In a sense, this was a test of the "validity" of the derivation of the conceptualization. It meant relating a carefully worked out and precisely defined conceptualization and measurement to a broad, vague, and variously defined "criterion". One might well anticipate failure in such an effort in spite of the fact that the "overall global rating" has been one of the most useful, if cumbersome, measures of "creativity".

The first prediction study was of this nature. A letter was sent to all members of the Vassar Faculty requesting them to rate a list of students on a scale from 1 to 6 in any area in which they had been in contact. The numerical ratings were described as: 1) superlative; 2) outstanding; 3) above average; 4) routine; 5) poor; 6) very poor. The students were selected from three samples (VCFr60A, VCFr60B, and VCSr60) on the basis of their Efficiency scores, as the best single indicator of intuitive problem solving ability. The group to be rated consisted of the highest 37 scorers and the lowest 32 scorers, a total experimental sample of 69, drawn from a parent population of 184.

It was hypothesized that individuals who showed high Efficiency scores on the problem solving scale represented a more successful, creative, and contributing group than did the low Efficiency, Ss, and that these differences would appear in their chosen activities, whatever the activity might be. For this reason, the evaluation was to be based on any area of contact, with the area specified by the rater.

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[3]. Many of the findings in this section have been reported elsewhere (Westcott & Ranzoni 1962, 1963 in press)

The results of this study were quite disappointing. Of 175 questionnaires sent out, only 60 were returned, and the results of these yielded such poor results that a full-scale follow-up for the rest of the returns was not indicated. A summary of the findings appear in Table 13.

Some freshmen, presumably the least visible ones, received no ratings at all, and it is evident that the average number of ratings per person is higher for seniors than for freshmen. The levels of the ratings are not significantly different between high and low Efficiency subjects for any sample, but it is worth noting, with caution, that in each case, the high Efficiency subjects receive lower (better) ratings on the average than do the low Efficiency.

It was felt that such global ratings had serious disadvantages, at best, and that a good bit more needed to be known about the laboratory characteristics of intuitive problem solvers before meaningful questions could be asked of raters. Such a rating study is in progress at the time of this report, since a great deal more is now known about the extreme subjects.

A second prediction study was carried out using academic performance as the criterion. This represents a clear and objective measure of college success. While it was by no means assumed that intuitive problem solving, as measured, was all that went into academic achievement, or vice versa, it was expected that the more efficient problem solvers would show a higher degree of success in academic work. The data concerning this prediction appear in Table 14. Six samples, as indicated, were used in this study. It is evident that none of the intuitive problem solving measures correlated significantly with cumulative academic performance.

A similar study of the relationships between academic aptitude as measured by the Scholastic Aptitude Tests of the College Entrance Examination Board was carried out on the same samples with somewhat more promising results. These data appear in Table 15. The correlations between the problem solving scores and the SAT Verbal scores are generally low and variable, but the correlations between problem solving measures and SAT Mathematical scores are quite consistent from sample to sample. High Mathematical aptitude is related mildly, but consistently to low Information Demand, somewhat more strongly to Success, and very reliably related to Efficiency.

This finding raised the question as to whether the problem solving scale was loaded with numerical material. While this is properly a problem for the technical section of the report, it did not arise until this point, and will be treated here. The verbal and numerical part scores, previously computed on one sample were correlated separately with the SAT scores. These appear in Table 16. The indications are that there is no disproportionate loading of numerical material being fed by

Mathematical aptitude, and the correlation between SAT Mathematical scores and the verbal part-scores are higher than between SAT Mathematical and the numerical part-scores. It remains true that mathematical ability must be related to the overall task of intuitive problem solving, but it is not peculiarly related to the numerical items.

These prediction studies were followed by one more effort in the area of personality dimensions. Three personality dimensions were selected due to their presumed relevance to the problem solving scores and the availability of the materials on a large number of the subjects already tested. These three dimensions were Impulse Expression, Flexibility, and Manifest Anxiety. The first two dimensions are measured by scales which are part of the Vassar College Attitude Inventory, developed by the Mellon Foundation at Vassar College (cf. Sanford, et. al., 1957) and the third is a well-established and frequently used measure (Taylor, 1953). The personality scale appears in the appendix as Fig. 5.

It was hypothesized that the following relationships would obtain between the various problem solving scores and the personality measures: Impulse Expression (IE) would be related negatively to Information Demand, in that these both represented a tendency to act quickly--with or without adequate basis for action, and with or without success; Flexibility (Fl) as a measure of adaptability would relate positively to Efficiency, as the best single measure of problem solving skill, and hence, cognitive adaptability. The relationships between Manifest Anxiety (MA) and problem solving scores were by no means as clearly predictable, and a variety of hypotheses were possible, many of them contradictory. For example, a high level of anxiety could force an individual into cautious behavior, and yield a positive correlation between MA and Information Demand; a low level of anxiety could be a function of a cautious and secure approach to life and yield a negative correlation between MA and Information Demand; a high level of anxiety could lead to both impulsiveness and caution in different individuals and yield no correlation between MA and Information Demand. Even with these difficulties, it was felt that anxiety was an important aspect--either as cause or as effect--of this kind of problem solving, so MA was included in the battery.

The data for six separate samples appear in Table 17. It is evident that the relationships between the three personality variables and the three problem solving scores are weak and unstable, varying not only in magnitude from sample to sample, but in direction as well, for most of the nine comparisons. The most reliable statements which can be made are as follows: Information Demand appears to bear a slight negative relationship to IE, in accord with the hypothesis--a low demand for information is somewhat related to impulsiveness; Information Demand bears a slight negative relationship to Fl, that is, individuals who are flexible tend to require less information than individuals who are not

so flexible; Success tends to be negatively related to MA, that is, anxious people tend to reach fewer correct solutions than do non-anxious people; Efficiency, as a combination of the other two problem solving scores tends to be positively related to F1 and negatively related to MA--the least anxious and most flexible people are the most efficient problem solvers. All of these "most reliable" statements must be offered with a great deal of caution, in spite of their apparent reasonableness.

Having explored a variety of fairly specific predictions concerning the differential performances of individuals who are stably differentiated on their problem solving strategies and success, and having found the predictions to be generally unsuccessful, a non-predictive, exploratory approach was next attempted.

The three dimension personality scale which has already been described was subjected to an item analysis. Three samples, (VCFr60A, VCFr60B, and VCSr61) were selected, and from this pool of 195 subjects, those who were at least 1 S.D. high or low on both Information Demand and Success were identified. This provided four groups representing fairly pure and extreme types of problem solving performance.

The groups were composed as follows: 10 subjects were found to be at least 1 S.D. low on Information Demand and at least 1 S.D. high on Success. These are, by definition, successful intuitive thinkers, and are identified as Group 1. Seventeen subjects were found who were similarly at least 1 S.D. low on Information Demand, and at least 1 S.D. low on Success. These are described as unsuccessful wild guessers, and identified as Group 2. There were 22 persons found 1 S.D. high on Information Demand and 1 S.D. high on Success. These are described as careful successful problem solvers, and identified as Group 3. Finally, 20 subjects were 1 S.D. high on Information Demand and 1 S.D. low on Success. These are said to be careful, but unsuccessful problem solvers, and are identified as Group 4.

For the item-analysis, the groups were combined in various ways which are detailed in conjunction with the results below. Chi-square was computed between groups for each of the three sub-samples (VCFr60A, VCFr60B, VCSr61) separately, and for the three sub-samples combined. Any item was said to discriminate between groups if it met the following multiple criterion: Chi-square significant at the .05 level must be obtained for the three samples combined; Chi-square significant at the .05 level must be obtained for at least one of the sub-samples; all three samples must split in the same direction. This multiple criterion was necessary due to the small sizes of the sub-samples, and in addition, provided a cross-validation.

The first analysis combined the two groups of low Information Demand subjects and compared them with the two groups of high Information Demand subjects, that is, Groups 1 and 2 were compared with

Groups 3 and 4. The items which differentiated along the dimension of Information Demand at the .05 level of confidence appear in Table 18.

From these 12 discriminating items, it appears reasonable to infer that the low Information Demand subjects are relatively labile, affectively involved in what they are doing, and comparatively unsocialized. In contrast, the high Information Demand subjects may be seen as cautious, conservative, and compliant.

The second comparison was between the high Success groups and the low Success groups, that is, Groups 1 and 3 were combined and contrasted with Groups 2 and 4 combined. The items which discriminate along the dimension of Success at the .05 level are indicated in Table 19.

While there is considerably less here on which to base any inference, one may note that confidence may be indicated among the high Success subjects and anxiety among the low Success subjects.

An attempt was next made to discriminate between the high and low Success groups, both of which demand little information, i.e., between Groups 1 and 2. The items which met our criterion for discrimination appear in the upper part of Table 20. Note that in the lower part of the table, none of the items meet the .05 level of confidence, but all meet the .10 level.

Here the subjects who are successful intuitive thinkers, by definition, show an apparent confident comfort both with themselves and with unconventionality in the world about them, while the wild guessers appear quite desperate and anxious.

Finally, an attempt was made to discriminate between Group 3 and Group 4, that is, between the extremely successful and the extremely unsuccessful subjects, all of whom demand a great deal of information. The items which discriminate appear in Table 21.

The high Success subjects in this high Information Demand group can apparently season their caution and compliance with at least a consideration of incautious behavior. They are confident, and apparently dislike a lack of confidence and certainty in other people. In contrast, the very unsuccessful people appear defensive and quite moralistic about their deficiencies.

From these findings, we conclude that there are significant differences in the ways in which these groups of individuals, identified by their problem-solving tactics and success, view their world and their relation to it. The successful intuitive thinkers are unconventional, affectively involved, confident and comfortable; the wild guessers are unconventional, affectively involved, but desperate and anxious; the steady successful problem solvers are cautious, orderly and confident, but can consider the possibility of behaving somewhat more erratically;

the careful but unsuccessful problem solvers are cautious and compliant, but defensive and moralistic about themselves and the world.

Following this rewarding item-analysis, interviews were held with the extreme performers identified in two samples from the same parent population, (VCFr60A and VCFr60B). The group designations refer to the same extremes as in the item-analysis. In the interview samples, Group 1, N=7; Group 2, N=13; Group 3, N=14; and Group 4, N=14.

Each subject was interviewed individually for approximately one hour. They were scheduled in a random order, and the interviewer had no knowledge of the group membership of any interviewee. The interviews were oriented around the following series of questions: 1) what reactions did you have to the testing sessions? What can you remember? 2) What do you like? 3) Has there been any marked change in your interests or likes during the past few years? 4) Is there anything among the things we have talked about, or elsewhere, which reaches the magnitude of a "consuming passion" for you? 5) Do you like to take chances? 6) Has there been anyone in your life you feel has been particularly influential on you?

It is not possible to treat all of the material in detail, but certain quantitative and qualitative differences may be noted. Each question will be dealt with below, some very briefly, some in more detail. A summary of the quantiative differences appear in Table 22. The entries are percentages of each group responding as indicated and the differences computed as differences between uncorrelated percentages.

The first question yielded marked differences concerning the degree of positiveness with which the problem solving task was approached. Positive reactions such as, "...I loved it..." or "...it was fun..." were obtained from 86% of Group 1, from 38% of Group 2, from 50% of Group 3 and from 14% of Group 4. Groups 1 and 3, the high Success groups are clearly more frequently positive in their reactions to the problem solving task than are the low Success groups, and the intuitive thinkers, Group 1, appear to take more joy in this task than any of the other groups. The hard-working failures, Group 4, are clearly low.

Except for Group 4, all responses which were not clearly positive were essentially neutral: "I tried to follow the directions...", "I worked hard on it...". For Group 4, on the other hand, 50% of the reactions reported were clearly negative: "I hated it...", "It bothered me; I like to know what's going on...". Thus, satisfaction and pleasure with the testing procedure was clearly related to the level of success, although there was no knowledge of results available to the subjects during the testing or afterwards, and they had no explicit knowledge of group membership. It is worth noting that at least some of the failures in both Groups 2 and 4 enjoyed it.

The second question, "What do you like?" released a torrent of

delights from some interviewees and inarticulate puzzlement from others. After varying amounts of clarification and encouragement, a variety of likes and interests were elicited from each subject. The great bulk of the interests noted for all groups can be identified under the following headings: 1) people, 2) reading, 3) art, 4) music, 5) sports. There were differences in the frequency with which the different groups mentioned these interests or likes, and we may note that Group 1, the intuitive thinkers, showed a significantly greater proportion of mentioned interest in reading and music than did the other groups combined; Group 2, the wild guessers, showed a significantly lower proportion of mentioned interest in people than all other groups combined; Group 3, the careful successes, showed a greater proportion of members interested in art, and Group 4, the cautious failures, did not stand out from the others on any of these interests. All groups were interested in sports, and while Group 1 is higher than the others, the difference is not statistically significant.

Of at least equal importance is the extent to which subjects were interested in and participated in creative expression. When an interest in art, music, literature or drama was mentioned, an attempt was made to find evidence of participation or production. The differences along this dimension were striking. In Group 1, 86% of the subjects worked creatively, most of them in writing. In Group 2, only 38% participated, of Group 3, 57%, mostly in graphic areas, and in Group 4, 50% produce in a variety of areas. Statistically, Group 1, the intuitive thinkers, is higher than the others combined, and Group 2, the wild guessers, is lower than the others combined.

In addition to these concrete differences in interests, there are qualitative differences well worth noting. Group 1 showed interest in and concern with over-arching abstract questions of esthetics, epistemology and human values. Members of this group frequently voiced interest in "Truth...", "beauty...", "...the time dimension in art...", "...communication...", "...sharing...", etc., while concerns of this nature appeared to be absent in the other groups. The members of Group 1 often articulated these problems with startling clarity and brilliance.

The question of change "over the past few years" was not restricted to the college years, but ranged more widely through high school and preparatory experience as well. As a matter of fact, no changes beyond those introduced by the classrom situation or contact with professors were attributed to the college experience at all.

More than half of Groups 1 and 4, the most intuitive and least intuitive problem solvers, report profound or significant changes while less than one quarter of each of the other groups report such changes.

It is not an obvious nor direct inference, but it may be that both these changeable groups are struggling for new levels of integration:

the successful intuitive thinkers because of their current successful grasp of relatively ordinary problems and the vastness of the special problems which do concern them; the inept problem solvers may recognize change because of a shaky and unsuccessful cognitive grasp of the world, coupled with a cautious doggedness and distrust of their own resources.

The extent to which the four groups acknowledge "consuming passions" is illuminating. On this dimension we find less difference in the frequency of consuming passions than in the content of such passions. In Group 1, 56% acknowledge such involvement, and specify in some detail; in Group 2, 31% respond affirmatively to this question; in Group 3 it is 50% and in Group 4, 43%. There are no significant differences in simple frequency but Groups 1 and 2, the intuitive thinkers and the wild guessers, tend to be the extremes.

Again, the qualitative differences are of interest. Some of the passions voiced by Group 1 are "love and sharing," "analysis and criticism," "to be myself at all costs." In contrast, the other three groups have consuming passions for "getting lost in modern novels," "men," "personal freedom," "exotic foods," "doing things with children," "horses." The breadth and abstract nature of the passionate concerns of Group 1 stands in sharp contrast to the much more concrete foci of the other groups.

The Question, "do you like to take chances?" elicited marked differences in the groups. Responses were scored as positive, negative, or ambiguous, and some qualitative differentiations are made within each category. Group 1 is 100% in favor of taking chances. Their risks run from physical danger as in ski jumping or mountain climbing to the ego risks of battling for lost causes or travelling considerable distance to drop in on a boy friend unannounced. They recognize risk in these activities and their positive responses are enjoyments of risk and recognition that "...you've got to, if you're going to live life to the hilt."

Group 2 showed 62% positive responses, but these tended to be tolerant rather than pleasurable. Only 1 member of Group 2 actively enjoyed the feeling of risk, while the others accepted it, apparently as an obligation.

Both Groups 3 and 4 show only 36% who clearly tolerate risk. This is in accord with their more cautious behavior on the problem solving task. In Group 3, 43% flatly deny that they take risks. They say "I like things to be certain...," "I'll take a sure thing every time...," "It's a sin to risk your life or health." Group 4 shows an unusually large proportion who don't know whether they like to take chances or not. "Yes" or "no" responses were qualified downward or upward to ambiguities by fully 50% of the subjects.

A few interpretive comments may be in order here, but they are

meant to be hypotheses rather than supportable conclusions. It may be that the members of Group 2, affectively labile, anxious and desperate --take risks without pleasure in an attempt to find and experience some of the things which they lack as a result of their non-commitment and unimpassioned interaction with the world outside themselves. It may be that the ambiguity of Group 4 is based on a feeling that there is not much choice about taking chances: even when things are as certain as possible, any action is still a risk and liking or disliking to take chances isn't a very meaningful distinction. It is worth noting that the ego risks seen in Group 1 do not appear in any other group. It is reasonable to hypothesize that risk of this variety demands an extraordinary degree of self confidence or, on the other hand, an extraordinary degree of insensitivity. The latter does not seem to be the case.

Influence felt from others also differentiates the groups. In Group 1, 70% report profound or significant influence from others, in Group 2, 50% acknowledge such influence, Group 3 reaches a low of 14%, and Group 4, 36%. It is particularly interesting that Group 3, the most clearly socialized and socially acceptable group deny being influenced, while Group 1, the group which apparently has the greatest individual resources acknowledges influence most often.

Differences among the groups appear in the kinds of influence felt, too. Briefly summarized, Group 1, the intuitive thinkers, acknowledges influence from persons who displayed enthusiasm, commitment or intensity of living. Examples of behavior in others apparently are sufficient to affect these people while the other groups require more direct exhortation and instruction in relatively concrete ways in order for them to recognize influence. Groups 2, 3, and 4 identify influential persons, particularly professors, by reporting, "he made me think ...," "he made me absorb...," "he taught me to write...." Group 1, on the other hand, characterize the influential persons as "...so intense," or "...he loved his field."

Interpretively, we may raise the hypothesis that members of Group 1 are willing and able to accept influence by example which moves them in productive directions; Group 2 members do not have sufficiently clear views of themselves and their goals or paths to embrace influence willingly; Group 3 members are and have been so stable and successful within a conventional framework that they are relatively impervious; Group 4 members are probably not aware as to whether they are influenced or not--much as they are unaware as to whether they like to take chances or not.

The interview terminated with the administration of an adjective check list,[4] which will be discussed next.

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[4]. A copy of the adjective check list appears in the appendix as Fig. 6.

The check list which consisted of 307 words arranged alphabetically, was given to each interviewee with instructions to check those adjectives which applied to her. She was encouraged to do it quickly and to not worry about discrepancies or contradictions. About 5 minutes was usually sufficient time to complete the form.

In Table 23 appear all the words which differentiated individual groups or logical combinations of groups. Each entry is the percentage of a group checking that adjective. As in the personality scale study, the groups were combined in various ways for analysis. In the table, underlining of two groups indicates that they are significantly higher than the other two; underlining of a single group indicates that it is significantly higher than the other three groups combined; parenthesizing a single group indicates that it is significantly lower than the other three groups. The level of confidence for each difference is indicated in the right-hand column.

It appears that the low Information Demand Groups (1 and 2) are distinguished by the perception of themselves as alert, demanding, sharpwitted, and quick. They describe themselves in these terms more often than do the high Information Demand groups. It is evident, however, that the bulk of the difference on both demanding and sharpwitted can be attributed to the zero frequency found on these adjectives in Group 4.

The high Information Demand groups (3 and 4) combined are distinguished by describing themselves more often than the other groups as anxious, cautious, kind and modest. There do not appear to be any disproportionate loadings on these adjectives by a single group.

Along the dimension of Success, we find the high Success groups (1 and 3) check confident, foresighted, informal, resourceful and spontaneous, more often than do the low Success groups combined. Individual groups stand out in the following ways: Group 1 is significantly higher than all the others on independent; Group 2 is significantly higher than the others on cynical and headstrong, and lower on conscientious; Group 3 does not stand alone on any descriptive term, and Group 4 is significantly low on self-confident, demanding, sharpwitted, cynical and headstrong.

A self description of each group then might be as follows: Group 1 members see themselves as alert, quick, confident, foresighted, informal, resourceful, spontaneous, and independent. Members of Group 2 see themselves as being alert, quick, cynical and headstrong. Group 3 members see themselves as cautious, kind, modest, confident, foresighted, informal, resourceful and spontaneous. Group 4 is distinguished as being cautious, kind, modest, and lacking in self-confidence, while not at all cynical, sharpwitted, demanding, or headstrong.

From the various data gathered in this empirical phase of the research, we may offer an integrated, albeit tentative, description of

the characteristics typical of the various groups defined by their tendency to approach problem solving intuitively and their tendency to be successful in such an approach. It is evident that the more standardized measures--the SAT scores, the college grades, and the personality scales offer less discrimination among the groups than do the other data--the item analysis, the interviews, the self-concept materials. In the description below, the various data will all be utilized to contribute whatever they can to the picture.

The members of our first group, the successful intuitive thinkers, tend to have slightly higher numerical aptitude than do the unsuccessful problem solvers, but the difference is not great. Their verbal aptitudes are not distinguished from those of less efficient problem solvers, and their college grades do not stand out as high or low in any way. There is some tendency for the intuitive thinkers to be more impulsive and flexible than the others, but not strikingly so.

However, there are some rather striking features which distinguish these people from others. These subjects are unconventional, and comfortable in their unconventionality. They are deeply involved emotionally in what they are doing and tend to experience fluctuations of affect which do not worry them. They are not afraid of themselves, their experiences, or their world, and they tend to accept challenge readily and eagerly. They can live with doubt and uncertainty, even enjoying risk and seeking out instabilities in the world. They are willing to commit themselves to causes and are able to become wrapped up in them; the causes and concerns which capture their imagination appear to be sweepingly abstract issues, either at the level of academic-intellectual problems, or problems in human values. They are willing and able to create--to commit themselves to paper, to be criticized, to expose themselves, and they take chances both willingly and eagerly. Their interaction with the world is such that they can and do change profoundly and accept influence from others as it may further their own development. They assess themselves much the way an observer might assess them: as alert, independent, foresighted, confident and spontaneous.

Our second group, those subjects who attempt intuitive problem solving, but fail, share some of these characteristics, but are clearly distinguishable. They tend to be near the average of the groups combined on both verbal and numerical aptitude, and their grades are not distinguishable from those of other groups. They do tend to be somewhat impulsive but are less flexible than the successful subjects. These differences, even if real and stable, are extremely small. The members of this group tend to share unconventionality with the successful intuitive thinkers, but their unconventionality appears to be a desperate anxious variety of deviation, and they appear to be driven to be different. They seem to gain little personal satisfaction or fulfillment from marching to their own drummers. They are emotionally involved, but the affect appears to be more concentrated on self-absorption than on productive task-orientation. They are fearful in crises and appar-

ently accept challenges and risks more with grim desperation than with confident zest. They are less frequently interested in other people than are the other groups, perhaps reflecting their self-concern, and they are not inclined to produce creatively nor to be deeply involved in a consuming problem, cause, or activity. They do not recognize changes of great significance in themselves, in spite of the fact that they feel themselves influenced by others. Perhaps they move rapidly through the world without moving in any recognizable productive direction. They see themselves as alert, quick, headstrong and cynical--to which description this observer might add anxious and troubled.

The third group, subjects who solve problems well, basing their successful judgments on a great deal of information are also evenly distributed in their Scholastic Aptitude Test scores and in their college grades. They tend to be less impulsive than those who demand little information, and they share to some extent the flexibility of the other successful problem solvers. Flexibility is not, however, an outstanding trait, and more characteristically they are cautious, conservative and compliant. They are well socialized and while they rarely behave erratically, they can entertain the possibility of incautious behavior. They tend to be interested in art more than the other groups do, and they produce to some extent in this area, generally enjoying it. They do not recognize themselves as having changed very much, and they acknowledge almost no profound influence on their lives. They represent both a successful problem-solving capacity and a very acceptable social picture; change would be a serious risk to their success and stability in both dimensions, and they explicitly deny that risk is an enjoyable or desirable enterprise. They can be swept to a very involved level by some things, but these generally come from outside themselves; they are more likely to be captured by a mass movement than to lead one or to travel far alone. They may be seen as relatively confident of their place in the world, and not involved in altering it. They see themselves mostly in terms of social virtues--cautious, kind, modest, confident, but they also describe themselves as resourceful, foresighted, and spontaneous. Indeed, within a firmly conservative and conventional framework, they have the best of both worlds--the social and the intellectual.

The final group, those who demand much information and fail in their attempts to solve problems, are comparable to the others on verbal aptitude, although they show somewhat depressed numerical aptitude scores. Their grades, however, do not reflect the problem-solving deficiencies which classify them as a group. They are low on impulsiveness, and they tend to be somewhat inflexible and anxious. These characteristics, however, are not striking deviations from the other groups. They share caution and conservatism with the immediately preceding group, but they are defensive about it, and cannot entertain the incaution which the preceding group can. This group lives in a world where everything is risky at best, and one always works to minimize risk. These subjects do not stand out in their interests, but most of them are inter-

ested in people and sports, involving themselves somewhat less than other groups do in more stringent intellectual concerns. Some of them participate in painting and music and writing, but excitement and emotional committment to these activities is rather rare. They acknowledge that they have changed, and that others have influenced them, although they have trouble being as specific on these points as some of the other groups. Their changes and felt influences appear to be less positive, progressive or cumulative than those of the other groups. They are not at all sure whether taking chances is desirable or undesirable, and indeed, they may not be sure whether they take chances or not. There may be no choice, just as there may be no choice about being influenced or about changing. Their most notable self-descriptive feature is their lack of self confidence which is coupled with caution, kindness, and modesty.

From these findings, it is evident that deep and important, although somewhat evasive differences exist among the four groups identified on the dimensions of intuitive problem solving. Certain approaches contributed far more to our understanding than did others, and it appears that the study of intuitive thinking may be hampered by the use of measures developed and standardized for the prediction of behavior on more conventional dimensions.

Unless there is a set of dimensions, however vague, operating in the world outside the laboratory--particularly the educational world--on which intuitive thinking can be evaluated, there can hardly be any expectation that laboratory measures will predict non-laboratory success. It may be that intuitive thinking, however highly praised in the abstract, is ignored in practice.

While this research has failed to demonstrate that intuitive thinking, as measured, contributes to any objectively assessed level of success, it has succeeded in demonstrating the existence of stable, psychologically coherent and meaningful complexes of behavior which may be identified on the dimensions of intuitive problem solving.

Conclusions and Implications

The conclusions to be drawn from these findings are relatively straightforward and may be conceived as statements relevant to each of the objectives of the research as stated earlier.

A conception of intuition is offered which has its starting point in an observation common to almost all treatments of intuition: the observation that individuals often reach conclusions on the basis of insufficient evidence. In many views of intuition--indeed most classical views--the reaching of conclusions by intuition is a non-rational and non-sensory process, and has the characteristic of absolute certainty and validity. Further, intuition, as presented philosophically is considered an all-or-none phenomenon, appearing in individuals who are specially endowed, or, on the other hand, appear in particular contexts in almost all persons. There are no psychological analyses of intuition which are in terms of well-defined psychological concepts, although some attempts have been made in this direction.

The conception offered in this research represents a firm step in declaring an area of psychology in which the concept of intuition might be analyzed, and represents an objective definition of intuition such that a methodology for investigating this phenomenon becomes possible. The view is offered that intuition is the reaching of conclusions on the basis of little information which are ordinarily reached on the basis of significantly more information. This view arises from the same observational base as other conceptions of intuition, yet it stays within the limits of empirically describable and objectively measurable behavior.

From this conceptualization, a method of measurement and investigation was derived. It is useful in that it meets the requirements of the definition, and the basic hypotheses concerning individual differences and individual stability in this behavior are adequately supported by empirical evidence. It has been demonstrated that the phenomenon of intuition appears to different degrees in different persons at varying levels of complexity and sophistication. Intuition, as defined, appears to differentiate school children as adequately as college students, and differentiation is stable with two different methods--problem solving of a relatively conventional sort, and the task we have called Perceptual Inference.

The third set of conclusions refers to the characteristics of individuals who perform in different ways on an intuitive problem-solving task. The four groups of extreme performers identified show meaningful differences in the ways they view the world, in their reactions to the world, and in their aims toward the world--differences which are hypothesized to have far-reaching implications for the conduct of their lives. While there is only minor differentiation among these groups of subjects on conventional objective measures of ability and personality,

the differences which emerge from self-descriptive and interview materials indicate basic and important differences.

The implications of this study are several. First, it is evident that a great deal more research following the same lines is possible, given the stable measurement methods and the firm theoretical conceptualization offered. Many questions may be asked and answered through this technique. Some of the specific questions of interest lie in the area of education and educational practices. As indicated by Bruner (1960) and by Taylor, et. al. (1959) the identification, encouragement, and utilization of intuition in the educational setting, at all levels from early elementary school on through professional training, and on further into professional work may be one of the hinges on which the continued progress of the sciences and arts will swing. It is of merit to note that there is considerable overlap between the findings of the present work on intuitive thinkers identified as relatively untrained and immature individuals and the results of studies of mature and eminent scientists, writers and artists. In particular, the descriptions of the present group of intuitive thinkers compares very favorably with the description offered by MacKinnon (1962 in press) of his group of "most creative" architects. The use of such a technique as the one presented in this research may well serve as a selection technique, or as a potential tool in efforts to identify exceptional talent early.

It is worth noting that many of the most eminent and "creative" individuals of our time showed no remarkable aptitude for conventional academic work (Taylor 1958), and the selection of unusually capable individuals early in their careers commits the educational system or institution to a continuing program of rather special and unorthodox treatment, in an effort to foster and facilitate the development of these talents. It would be of little use to select unusual and highly competent, intuitive, individualistic persons and expect them to be outstanding on restrictive, conventional, unchallenging tasks. It may well be that this is one of the reasons that our present correlations with "conventional" measures of academic potential and success are so low. It may also be the reason why so many of our academic selection methods yield such low success--not in predicting academic performance, but in predicting life-long contributions to society.

Thus, we conclude that the identification of individuals who represent various degrees of the complex capacity for intuitive thinking is feasible, and that individuals so identified are quite different from each other in ways which are psychologically meaningful. We further conclude that their views of the world are relatively unconventional and individualistic, calling for rather special treatment if their intuitive problem solving capacities are to be fostered to their fullest, and their desirable talents are to be brought to bear on problems meaningful to society.

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A P P E N D I X

Figure 1. Instructions for the intuitive problem solving scale.

INSTRUCTIONS

Here are twenty problems for you to solve. Each problem is separate from the others. Clues are provided to help you arrive at the solution for each problem. You are to solve each problem using as few clues as possible.

For each problem the clues which will help you solve it are covered by foil seals which you can see through the openings in the problem board. Pressing your stylus through the foil and pushing the foil back allows you to see a clue. There is a clue in each seal.

In some of the problems part of the answer is already on the answer sheet, so be sure to look at the answer sheet before you attack each problem. In reaching your solution to any problem you must reach a final solution as though you had used ALL THE CLUES for that problem - both those you have seen and those you have not seen (see example below).

If you think you know the solution to a problem without looking at any clues, go ahead and write it on the answer sheet in the appropriate place. If you want to see a clue, carefully break the foil in the first opening. If, when you see the clue, you think you know the answer, write it down. If not, carefully break the next seal, and so on until you either reach a solution or you have exhausted the supply of clues. Use the clues in order. Give a solution to each problem no matter how unsure you may be. Be careful that you do not break a seal unless you really need the clue which is covered by that seal. Inspect your problem board now to be sure all seals are intact. If any are broken, report this to the examiner.

One's first reaction may be - "... but what is the problem?" The use of clues will help you decide what the problem is - and then help you arrive at the solution to it.

Figure 1. (Continued)

Your confidence in the solutions you reach will vary from problem to problem. Please indicate how confident you are of each solution by placing the appropriate number from the following scale after your solution.

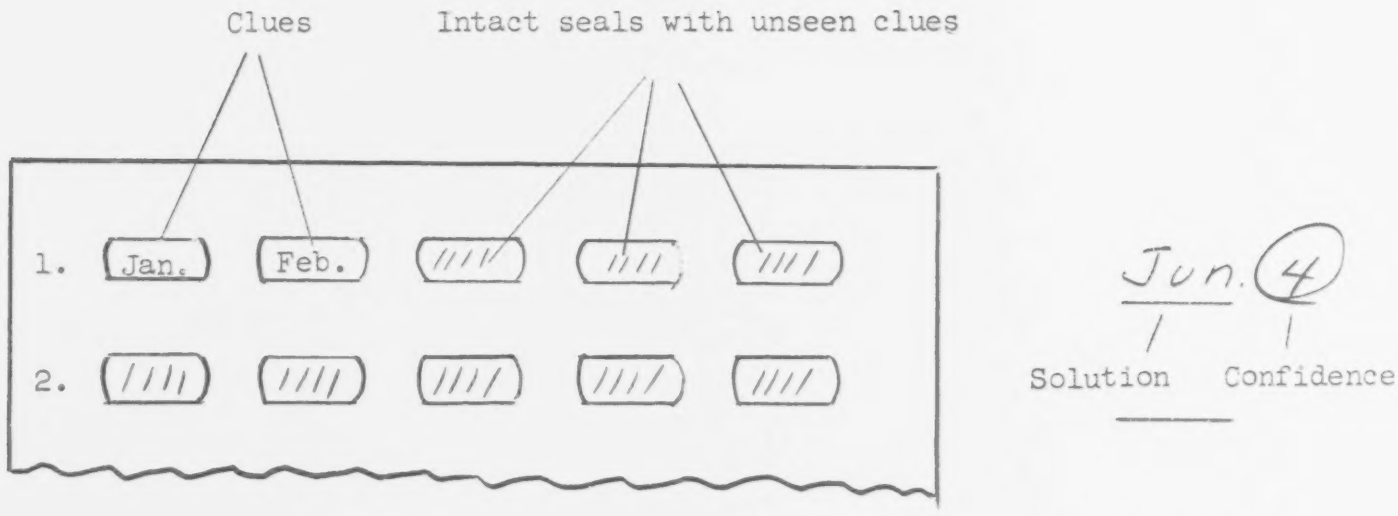
(4) certain
(3) fairly confident
(2) unsure
(1) wild guess

Draw a circle around your confidence rating to distinguish it from your solution to the problem. There is no time limit, but we will record how long each person takes on the task. Take as much time as you want, but do not waste time.

You may use the back of the answer sheet for scratch paper if you wish. Work independently and please do not talk about the experiment with anyone. We will be using a great many people as subjects and advance knowledge about the experiment will invalidate our work and make it useless. When you are finished, give your problem board and answer sheet to the experimenter.

REMEMBER: THE OBJECT IS TO WORK OUT THE SOLUTION TO EACH PROBLEM USING AS FEW CLUES AS POSSIBLE.

Example of a problem solved correctly.

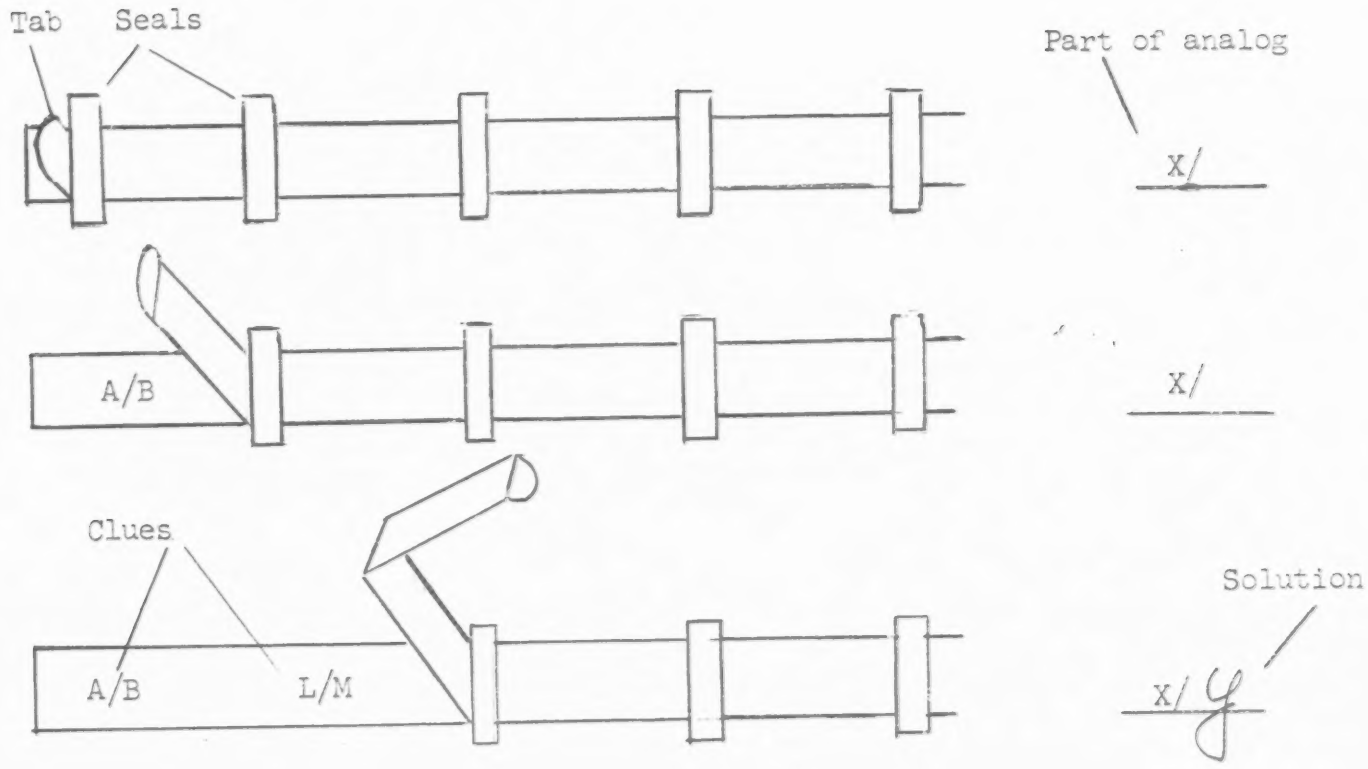


Note that the answer makes use of the three clues which were not seen, as per the instructions.

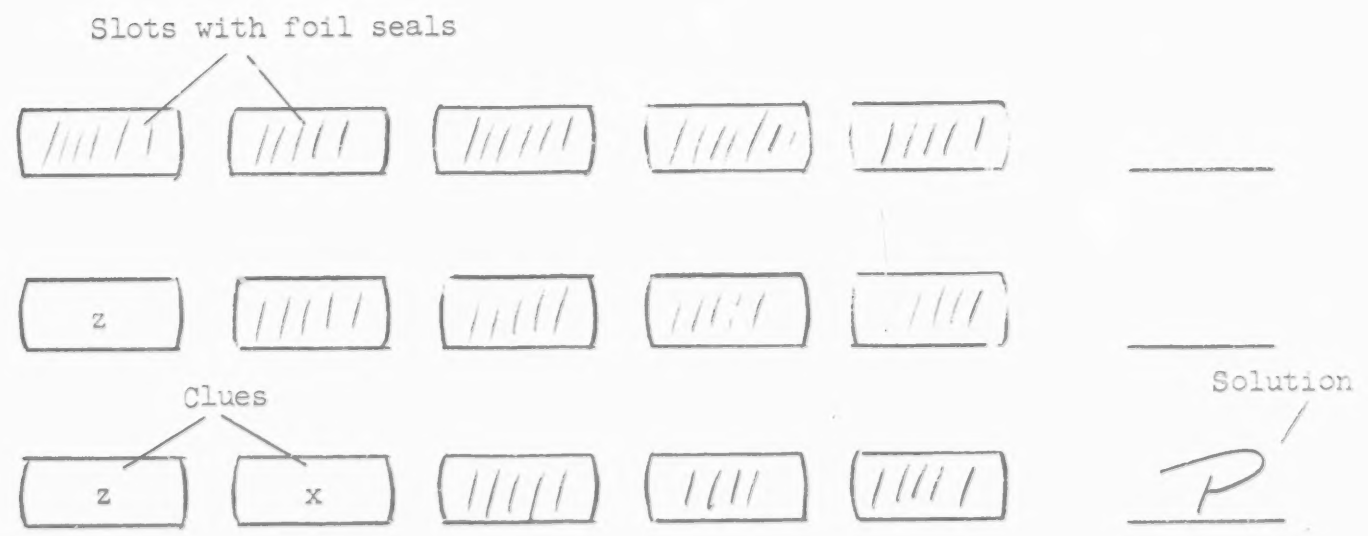
CLUES					ANSWERS*
1	2	3	4	5	6
over under	in out	short long	down up	black white	high low
B C	C D	D E	E F	F G	G H
DRAB BAR	LOT TO	TRAP PAR	TAPS SPA	TRAM MAR	STEM MET
Z	X	V	T	R	p
312-4	8-2	15-4	351-1	242-2	216 -1
N	N E	E	S E	S	S W
12321	23432	34543	45654	56765	67876
carouse	arouse	rouse	ouse	use	se
ADZ	BOY	COX	DEW	ELV	FLU
326-1957	732-6195	573-2619	957-3261	195-7326	619-5732
boat ship send	tar pitch toss	tavern bar rod	fee tip end	thin lean tilt	plank board meals
stripe 123456	strip 12345	trip 2345	pier 5463	pest 5612	sip 145
DOC DUD	RID ROE	SEW SIX	COD CUE	TAM TEN	TAR TES
3692-4	216874-6	31-2	26915-5	9-1	6857392 -7
FAT	GET	HAT	1ET	JAT	KET
9N	8E	6S	4F	7S	2 T
12	2	23	3	34	4
carts cart	holds hold	form for	howl how	bar ba	so s
no tone	ma name	at star	lo fold	mi time	sa wasp

*Underlined portions of answers are already presented on the answer sheet.

Figure 2. A set of problems and solutions for intuitive problem solving.

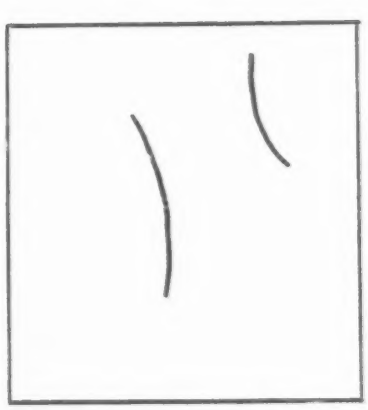


An analogy problem in three stages of exploration in the tab-seal format.

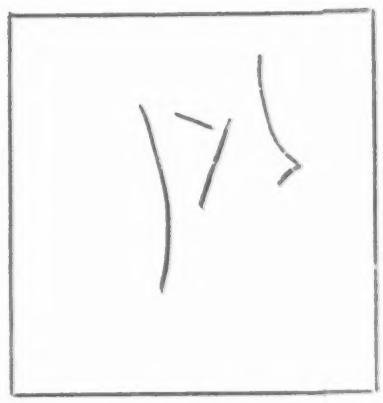


A series problem in three stages of exploration in the masonite-foil format.

Figure 3. Formats for the presentation of an intuitive problem solving task


1

2


3

4

5

6

7

Figure 4. Examples of fragmented pictures for Perceptual Inference. For experimental purposes each is presented on a 5 x 7 card.

Figure 5. The three-dimension personality scale

NAME: SEX: AGE:

INVENTORY

This inventory consists of numbered statements. Read each statement and decide whether it is true (T) as applied to you or false (F) as applied to you. If the statement is true or mostly true as applied to you, scratch out the letter T to the left of the statement. If the statement is false or not usually true, as applied to you, scratch out the letter F to the left of the statement. Remember give your own opinion of yourself. There are no "right" or "wrong" answers. Make a decision on each statement, do not skip any of the statements. If you are not sure, or if you feel that a statement does not apply to you, you should still give the best possible guess, even though you may have some reservations about it.

T. F. 1. I always see to it that my work is carefully planned and organized.
T. F. 2. I like to have a place for everything and everything in its place.
T. F. 3. I enjoy discarding the old and accepting the new.
T. F. 4. I am easily embarrassed.
T. F. 5. I have often gone against my parents' wishes.
T. F. 6. I am unusually self-conscious.
T. F. 7. I dislike women who disregard the usual social or moral conventions.
T. F. 8. I believe women ought to have as much sexual freedom as men.
T. F. 9. Often I can't understand why I have been so cross and grouchy.
T. F. 10. I have had periods of days, weeks, or months, when I couldn't take care of things because I couldn't get "going."
T. F. 11. I would rather be a steady and dependable worker than a brilliant but unstable one.
T. F. 12. I work under a great deal of tension.
T. F. 13. In illegitimate pregnancies abortion is in many cases the most reasonable alternative.
T. F. 14. I am very seldom troubled by constipation.
T. F. 15. I have used alcohol excessively.
T. F. 16. In general I prefer the company of men to women (in sports, intellectual activities, hiking, theater, conversation, etc.)
T. F. 17. I often wish people would be more definite about things.
T. F. 18. I have had periods in which I carried on activities without knowing later what I had been doing.

Figure 5. (Continued)

T. F. 19. I go to church almost every week.
T. F. 20. It is annoying to listen to a lecturer who cannot seem to make up his mind what he really believes.
T. F. 21. I would enjoy fame (not mere notoriety).
T. F. 22. I believe there is a God.
T. F. 23. I would be uncomfortable if I accidently went to a formal party in street clothes.
T. F. 24. My sleep is fitful and disturbed.
T. F. 25. I am very careful about my manner of dress.
T. F. 26. I am usually calm and not easily upset.
T. F. 27. I would disapprove of anyone's drinking to the point of intoxication at a party.
T. F. 28. It is a good rule to accept nothing as certain or proved.
T. F. 29. My hands and feet are usually warm enough.
T. F. 30. I prefer men who are never profane.
T. F. 31. If several people find themselves in trouble, the best thing for them to do is to agree upon a story and stick to it.
T. F. 32. I don't like modern art.
T. F. 33. At times I feel like picking a fist fight with someone.
T. F. 34. People who seem unsure and uncertain about things make me feel uncomfortable.
T. F. 35. In religious matters I believe I would have to be called an agnostic.
T. F. 36. I am fascinated by fire.
T. F. 37. I set a high standard for myself and I feel others should do the same.
T. F. 38. I often start things I never finish.
T. F. 39. I like to go to parties and other affairs where there is lots of loud fun.
T. F. 40. I like dramatics.
T. F. 41. I don't like to work on a problem unless there is the possibility of coming out with a clear-cut and unambiguous answer.
T. F. 42. My way of doing things is apt to be misunderstood by others.
T. F. 43. Once I have my mind made up I seldom change it.
T. F. 44. Politically I am probably something of a radical.
T. F. 45. I have a great deal of stomach trouble.
T. F. 46. I have often either broken rules (school, club, etc.) or inwardly rebelled against them.
T. F. 47. I sweat very easily even on cool days.
T. F. 48. My home life was always happy.
T. F. 49. I almost never blush.
T. F. 50. I think I am stricter about right and wrong than most people.
T. F. 51. I feel that it is certainly best to keep my mouth shut when I'm in trouble.
T. F. 52. I have diarrhea once a month or more.

Figure 5. (Continued)

T. F. 53. People would be happier if sex experience before marriage were taken for granted in both men and women.
T. F. 54. I am often afraid I am going to blush.
T. F. 55. I would be uncomfortable in anything other than fairly conventional dress.
T. F. 56. I never make judgments about people until I am sure of the facts.
T. F. 57. I find that a well-ordered mode of life with regular hours is congenial to my temperament.
T. F. 58. The trouble with many people is that they don't take things seriously enough.
T. F. 59. I feel anxiety about something or someone almost all the time.
T. F. 60. Our thinking would be a lot better off if we would just forget about words like "probably", "approximately" and "perhaps".
T. F. 61. I have very few quarrels with members of my family.
T. F. 62. I have nightmares every few nights.
T. F. 63. A strong person will be able to make up his mind even on the most difficult questions.
T. F. 64. If I could get into a movie without paying and be sure I was not seen I would probably do it.
T. F. 65. At times I think I am no good at all.
T. F. 66. When I work on a committee I like to take charge of things.
T. F. 67. It's a good thing to know people in the right places so you can get traffic tags, and such things, taken care of.
T. F. 68. I wish I could be as happy as others seem to be.
T. F. 69. I never attend a sexy show if I can avoid it.
T. F. 70. I believe in a life hereafter.
T. F. 71. I am certainly lacking in self-confidence.
T. F. 72. I dislike a man who is frequently blunt in his speech.
T. F. 73. I work under a great deal of tension.
T. F. 74. At times I have been so entertained by the cleverness of a crook that I have hoped he would get by with it.
T. F. 75. It makes me nervous to have to wait.
T. F. 76. I find it hard to keep my mind on a task or job.
T. F. 77. I like to flirt.
T. F. 78. I am in favor of a very strict enforcement of all laws, no matter what the consequences.
T. F. 79. I often do whatever makes me feel cheerful here and now, even at the cost of some distant goal.
T. F. 80. I dream frequently about things that are best kept to myself.
T. F. 81. Sometimes without any reason or even when things are going wrong I feel excitedly happy, "on top of the world."
T. F. 82. I am entirely self-confident.
T. F. 83. Sometimes I feel that I am about to go to pieces.

Figure 5. (Continued)

T. F. 84. I certainly feel useless at times.
T. F. 85. I rather like "justifiable conceit" in a person of the opposite sex.
T. F. 86. I shrink from facing a crisis or difficulty.
T. F. 87. Some of my friends think that my ideas are impractical, if not a bit wild.
T. F. 88. I have been afraid of things or people that I knew could not hurt me.
T. F. 89. I am a high strung person.
T. F. 90. I pray several times every week.
T. F. 91. For most questions there is just one right answer, once a person is able to get all the facts.
T. F. 92. I have never done any heavy drinking.
T. F. 93. I blush no more often than others.
T. F. 94. I like to talk about sex.
T. F. 95. I think I would like to drive a racing car.
T. F. 96. I dominate many of the men I know of about my own age.
T. F. 97. I am inclined to take things hard.
T. F. 98. I have never indulged in any unusual sex practices.
T. F. 99. I am known as a hard and steady worker.
T. F. 100. I must admit that I have at times been worried beyond reason over something that really did not matter.
T. F. 101. Something exciting will always pull me out of it when I am feeling low.
T. F. 102. I don't like things to be uncertain and unpredictable.
T. F. 103. I have never done anything dangerous for the thrill of it.
T. F. 104. I am troubled by attacks of nausea.
T. F. 105. No man of character would ask his financee to have sexual intercourse with him before marriage.
T. F. 106. I would be ashamed not to use my privilege of voting.
T. F. 107. I worry quite a bit over possible misfortunes.
T. F. 108. It bothers me when something unexpected interrupts my daily routine.
T. F. 109. I have had very peculiar and strange experiences.
T. F. 110. Sometimes I feel like smashing things.
T. F. 111. I tend to ignore feelings of others when accomplishing some end that is very important.
T. F. 112. I like men of whom I am a bit afraid.
T. F. 113. I enjoy betting on horse races.
T. F. 114. Man's search for a purpose, ideal, mission, etc. is largely a search for a plot or pattern in his life story - a story that is basically without meaning.
T. F. 115. Children should receive no religious instruction of any kind.
T. F. 116. I am happy most of the time.
T. F. 117. I like to hear risque stories.
T. F. 118. I have frequently found myself, when alone, pondering such abstract problems as free will, evil, etc.

Figure 5. (Continued)

T. F. 119. I feel hungry almost all the time.
T. F. 120. I have been disappointed in love.
T. F. 121. I often get the feeling that I am not really a part of the group I associate with and that I could separate from it with little discomfort or hardship.
T. F. 122. I cannot keep my mind on one thing.
T. F. 123. I enjoy playing cards for money.
T. F. 124. I must admit I find it hard to work under strict rules and regulations.
T. F. 125. I rather like aloofness in a person I have just met.
T. F. 126. I have the wanderlust and am never happy unless I am roaming or traveling about.
T. F. 127. Once a week or oftener I become very excited.
T. F. 128. The unfinished and the imperfect often have greater appeal for me than the completed and polished.
T. F. 129. The only meaning to his existence is the one man gives himself.
T. F. 130. I believe I am no more nervous than most others.
T. F. 131. I dream frequently.
T. F. 132. At times I have a strong urge to do something harmful or shocking.
T. F. 133. I do not tire quickly.
T. F. 134. I have had periods when I felt so full of pep that sleep did not seem necessary for days at a time.
T. F. 135. I sometimes wanted to run away from home.
T. F. 136. I would do almost anything on a dare.
T. F. 137. I often feel as though I have done something wrong or wicked.
T. F. 138. I get excited very easily.
T. F. 139. I have had periods in which I lost sleep over worry.
T. F. 140. I go out of my way to meet trouble rather than try to escape it.
T. F. 141. I have very few fears compared to my friends.
T. F. 142. I think nearly anyone would tell a lie to keep out of trouble.
T. F. 143. I frequently find myself worrying about something.
T. F. 144. I am embarrassed by dirty stories.
T. F. 145. Many of my friends would probably be considered unconventional by other people.
T. F. 146. I have several times had a change of heart about my life work.
T. F. 147. Life is a strain for me much of the time.
T. F. 148. Most nights I go to sleep without thoughts or ideas bothering me.
T. F. 149. I have strange and peculiar thoughts.
T. F. 150. In school I was sometimes sent to the principal for cutting up.

Figure 5. (Continued)

T. F. 151. Moral codes are relevant only when they fit the specific situation; when situations differ they are merely abstract irrelevancies.
T. F. 152. Most of the arguments or quarrels I get into are over matters of principle.
T. F. 153. I like men who antagonize me somewhat.
T. F. 154. I hardly ever notice my heart pounding and I am seldom short of breath.
T. F. 155. I enjoy the company of strong-willed people.
T. F. 156. When someone talks against certain groups or nationalities I always speak up against such talk even though it makes me unpopular.
T. F. 157. At times I feel like swearing.
T. F. 158. As a youngster in school I used to give the teachers lots of trouble.
T. F. 159. I would like to be an actor on the stage or in the movies.
T. F. 160. Sometimes I become so excited that I find it hard to sleep.
T. F. 161. During one period when I was a youngster I engaged in petty thievery.
T. F. 162. I cry easily.
T. F. 163. I have been in trouble one or more times because of my sex behavior.
T. F. 164. A wise person thinks of life as a game; he is both in and out of the game and watching and wondering at it.
T. F. 165. I easily become impatient with people.
T. F. 166. Once in a while I feel hatred towards members of my family whom I usually love.
T. F. 167. Sometimes when embarrassed I break out in a sweat which annoys me greatly.
T. F. 168. I think I take primarily an esthetic view of experience.
T. F. 169. I frequently notice my hand shakes when I try to do something.
T. F. 170. Organized religion, while sincere and constructive in its aims, is really an obstacle to human progress.
T. F. 171. When a man is with a woman he is usually thinking about things related to her sex.
T. F. 172. I have periods of such great restlessness that I cannot sit long in a chair.
T. F. 173. I am more sensitive than most other people.
T. F. 174. It is all right to get around the law if you don't actually break it.
T. F. 175. I worry over money and business.
T. F. 176. I often feel as if things were not real.
T. F. 177. God hears our prayers.
T. F. 178. I would like to hunt lions in Africa.
T. F. 179. We cannot know for sure whether or not there is a God.
T. F. 180. It is hard for me to sympathize with someone who is always doubting and unsure about things.

Figure 5. (Continued)

T. F. 181. I often act on the spur of the moment without stopping to think.
T. F. 182. I have very few headaches.
T. F. 183. I sometimes keep on at a thing until others lose their patience with me.
T. F. 184. I have sometimes felt that difficulties were piling up so high that I could not overcome them.
T. F. 185. When I get bored I like to stir up some excitement.
T. F. 186. I like worldliness in people (not pseudo-sophistication).
T. F. 187. I have often met people who were supposed to be experts who were no better than I.
T. F. 188. I brood a great deal.

Figure 6. The adjective check list. Instructions were given orally or by a cover letter.

absent-minded
active
adaptable
adventurous
affected
affectionate
aggressive
alert
aloof
ambitious
anxious
apathetic
appreciative
argumentative
arrogant
artistic
assertive
attractive
autocratic
awkward
bitter
blustery
boastful
bossy
calm
capable
careless
cautious
changeable
charming
cheerful
civilized
clear-thinking
clever
coarse
cold
commonplace
complaining
complicated
conceited
confident
confused
conscientious
conservative
considerate
contented
conventional
cool
cooperative
courageous
cowardly
creative
cruel
curious
cynical
daring
deceitful
defensive
deliberate
demanding
dependable
dependent
despondent
determined
dignified
discreet
disorderly
dissatisfied
distractable
distrustful
dominant
dreamy
dull
easy-going
effeminate
efficient
egotistical
emotional
energetic
enterprising
enthusiastic
evasive
excitable
expressive
fair-minded
fault-finding
fearful
feminine
fickle
flexible
flirtatious
foolish
forceful
foresighted
forgetful
forgiving
formal
frank
friendly
frivolous
fussy
generous
gentle
gloomy
good-looking
good-natured
greedy
handsome
hard-headed
hard-hearted
hasty
headstrong
healthy
helpful
high-strung
honest
hostile
humorous
hurried
idealistic
imaginative
immature
impatient
impulsive
independent
indifferent
individualistic
industrious
infantile
informal
ingenious
inhibited
initiative
insightful
intelligent
interests narrow
interests wide
intolerant
intuitive
inventive
irresponsible
irritable
jolly
kind
lazy
leisurely
logical
loud
loyal
mannerly
masculine
mathematical
mature
meek
methodical
mild
mischievous
moderate
modest
moody
nagging
natural
nervous
noisy
obliging
obnoxious
opinionated
opportunistic
optimistic
organized
original
outgoing
outspoken
painstaking
patient
peaceable
peculiar
persevering
persistent
pessimistic
planful
pleasant
pleasure-seeking
poised

Figure 6. (Continued)

polished
practical
praising
precise
prejudiced
preoccupied
progressive
prudish
quarrelsome
queer
quick
quiet
quitting
rational
rattlebrained
realistic
reasonable
rebellious
reckless
reflective
relaxed
reliable
resentful
reserved
resourceful
responsible
restless
retiring
rigid
risk-taking
robust
rude
sarcastic
self-centered
self-confident
self-controlled
self-denying
self-pitying
self-punishing
self-seeking
selfish
sensitive
sentimental
serious
severe
sexy
shallow
sharp-witted
shiftless
show-off
shrewd
shy
silent
simple
sincere
slipshod
slow
sly
smug
snobbish
sociable
soft-hearted
sophisticated
spendthrift
spineless
spontaneous
spunky
stable
steady
stern
stingy
stolid
strong
stubborn
submissive
suggestible
sulky
superstitious
suspicious
sympathetic
tactful
tactless
talkative
temperamental
tense
thankless
thorough
thoughtful
thrifty
timid
tolerant
touchy
tough
trusting
unaffected
unambitious
unassuming
unconventional
undependable
understanding
unemotional
unexcitable
unfriendly
uninhibited
unintelligent
unkind
unrealistic
unscrupulous
unselfish
unstable
vindictive
versatile
warm
wary
weak
whiny
wholesome
wise
withdrawn
witty
worrying
zany
zestful

Table 1. Descriptive characteristics of the eight samples

Sample	N	Age M	Age Range	Sex
Oxf 55	30	25	20-40	27M 3F
VCSr 59	33	21	20-23	F
VCFr 60A	70	18	17-19	F
VCFr 60B	70	17.7	16-18	F
VCSr 60	44	21	20-22	F
VCSr 61	55	20.5	19-22	F
BF 61	28	19	17-30	F
BM 61	38	19	17-24	M

Table 2. Raw performance data on the eight samples

Sample	N	Form of Scale	No. Problems	Clues Available	ΣR M	ΣR SD	ΣC M	ΣC SD	Time (Min.) M	Time (Min.) SD	Confidence M	Confidence SD
Oxf 55	30	A	20	87	15.9	1.9	49.0	7.0				
VCSr 59	33	B	20	105	16.0	2.2	58.4	10.9				
VCFr 60A	70	C	20	104	14.7	2.6	52.4	7.5	46.1	14.0	66.4	6.3
VCFr 60B	70	C	20	104	14.9	2.6	47.9	7.3	38.7	12.1	66.0	7.0
VCSr 60	44	C	20	104	15.1	2.6	54.2	8.1	37.2	12.5	68.4	6.1
VCSr 61	55	C	20	104	14.4	2.7	54.7	9.3	33.3	11.0	66.5	6.5
BF 61	28	D	20	100	13.1	2.6	57.3	6.8	40.0	12.5	65.7	7.4
BM 61	38	D	20	100	13.7	2.7	58.1	10.7	37.2	14.1	60.4	8.7

Table 3. Split-half reliabilities of various test measures#

Sample	N	Σ R (Success)	ΣCz (Information Demand)	Σ R/ΣCz (Efficiency)
Oxf 55	30	r = .36*	rho** = .73	rho = .61
VCSr 59	33	r = .44	rho = .86	rho = .86
VCFr 60A	70	r = .61	r = .79	r = .71
VCSr 60	44	r = .40	r = .83	r = .73
VCSr 61	55	r = .64	r = .82	r = .64
BF 61	28	r = .42	r = .70	r = .62
BM 61	38	r = .72	r = .91	r = .74

\# Corrected by the Spearman Brown Formula
* $p < .05$; all others $p < .01$
** rho is presented for some of the calculations because the raw data were not available for two samples for the recalculation of r .

Table 4. Correlations between analogy part scores and series part scores.#

Sample	N	Σ R (Success)	Σ C (Clue Use)	Σ Cz (Information Demand)
VCFr 60A	70	.40**	.44**	.44**
VCFr 60B	70	.27*	.59**	.58**
VCSr 60	44	.30*	.65**	.68**
VCSr 61	55	.52**	.69**	
BF 61	28	.30	-.58**	
BM 61	38	.40*	.70**	

\# uncorrected
* $p < .05$
** $p < .01$

Table 5. Split-half reliabilities[#] based on halves of the scale balanced for difficulty*

Sample	N	Σ R (Success)	Σ C (Clue Use)	ΣC_z (Information Demand)	$\Sigma R/\Sigma C_z$ (Efficiency)
VCFr 60A	70	.62	.80	.74	.56

\# corrected by the Spearman-Brown Formula
* all r's $p < .01$

Table 6. Correlations[#] between verbal part scores and numerical part scores

Sample	N	R (Success)	C (Information Demand)	R/ C (Efficiency)
VCFr 60A	70	.27*	.51**	.27*

\# uncorrected
* $p < .05$
** $p < .01$

Table 7. Correlations between Information Demand (ΣCz) and Success (ΣR)

Sample	N	
Oxf 55	30	rho = .12
VCSr 59	33	rho = .04
VCFr 60A	70	r = .18
VCFr 60B	70	r = .24*
VCSr 60	44	r = -.05
VCSr 61	55	r = .21
BF 61	28	r = -.07
BM 61	38	r = -.20

* $p < .05$; all others $p > .10$

Table 8. Correlations between confidence and performance

Sample	N	ΣR (Success)	ΣCz (Information Demand)	$\Sigma R/\Sigma Cz$ (Efficiency)
VCFr 60A	65	.36**	-.17	.42**
VCFr 60B	64	.48**	-.04	.47**
VCSr 60	35	.45**	-.21	.50**
VCSr 61	47	.29*	-.28*	.38**
BF 61	28	.51**	-.24	.56**
BM 61	37	.73**	-.26	.68**

* $p < .05$
** $p < .01$

Table 9. Characteristics of "mean right" scores on Perceptual Inference for two samples of 5th & 6th grade students on two forms of the task.

Researcher	N	Range	Mean	S.D.	Split-half Reliability
Decker 1960	46	1.37-5.60	3.65	.99	.78
Leopold 1962	32	4.0 -6.38	5.46	.54	.66

Table 10. Correlations between "mean right" scores and IQ on three samples of 5th & 6th grade students.

Researcher	N	IQ TEST	
Decker 1960	20	Full WISC	r = -.68
	26	Group	r = -.18
Leopold 1962	32	Various	rho= -.16

Table 11. Characteristics of the "mean right" score on Perceptual Inference at different ages

Group	N	Mean Right Scores Range	Median
Nursery School	12	3.2 - 7.2	5.4
Grades 1 - 2	12	2.2 - 6.0	3.8
Grade 4	12	2.8 - 5.8	3.6
College	12	2.0 - 3.4	2.4

Table 12. Test-retest reliabilities of "mean right" scores on Perceptual Inference over a two-year period.

Sample	N	rho
A	16	.68
B	16	.40

Table 13. Distribution of faculty ratings on high and low Efficiency subjects

Sample		N	Mean No. of Ratings	Mean Level of Ratings	S.D. of Ratings
VCFr 60A	High	14	3.9	3.3	.77
	Low	12	3.1	3.8	.67
VCFr 60B	High	12	2.1	3.0	.75
	Low	11	3.0	3.4	.66
VCSr 60	High	9	5.2	3.1	.82
	Low	9	7.3	3.2	.69

Table 14. Correlations between scores on intuitive problem solving and cumulative credit ratio

Sample	N	Σ R (Success)	ΣCz (Information Demand)	ΣR/ΣCz (Efficiency)
VCFr 60A	63	.09	.12	.09
VCFr 60B	70	.11	.08	.05
VCSr 60	44	-.07	.24	-.12
VCSr 61	55	.05	-.11	.11
BF 61	28	.28	.07	.21
BM 61	35	-.05	-.29	.10

Table 15. Correlations between scores on intuitive problem solving and SAT Verbal and SAT Mathematical scores.

	Sample	N	ΣR (Success)	ΣCz (Information Demand)	$\Sigma R/\Sigma Cz$ (Efficiency)
	VCFr 60A	70	.19	-.12	.23
	VCFr 60B	68	.32**	.01	.29*
SAT	VCSr 60	40	.24	-.07	.06
V	VCSr 61	54	-.11	-.26	.13
	BF 61	25	.36	.08	.20
	BM 61	34	.20	-.15	.25
	VCFr 60A	70	.34**	-.09	.33**
	VCFr 60B	68	.23	-.25*	.35**
SAT	VCSr 60	40	.44**	-.14	.44**
M	VCSr 61	54	.25	-.04	.30*
	BF 61	25	.36	-.23	.38*
	BM 61	34	.43**	-.21	.49**

* $p < .05$
** $p < .01$

Table 16. Correlations of verbal and numerical part scores with SAT Verbal and SAT Mathematical scores for one sample (N= 70)

	12 Verbal Items			6 Numerical Items		
	ΣR (Success)	ΣCz (Information Demand)	$\Sigma R/\Sigma Cz$ (Efficiency)	ΣR (Success)	ΣCz (Information Demand)	$\Sigma R/\Sigma Cz$ Efficiency
SAT V	.10	-.13	.18	.19	.00	.19
SAT M	.24*	-.02	.24*	.18	.03	.15

* $p < .05$

Table 17. Correlations between intuitive problem solving scores and personality measures

Personality Measure	Sample	N	Σ R (Success)	Σ Cz (Information Demand)	Σ R/Σ Cz (Efficiency)
Impulse Expression (IE)	VCFr 60A	53	.34**	-.15	.37**
	VCFr 60B	50	-.11	-.13	-.04
	VCSr 60	38	-.10	.03	-.13
	VCSr 61	54	-.20	-.28*	-.06
	BF 61	28	.06	-.06	.16
	BM 61	37	-.33*	.36*	-.47**
Flexibility (Fl)	VCFr 60A	53	.21	-.03	.22
	VCFr 60B	50	.00	-.26*	.14
	VCSr 60	37	.28	-.21	.33*
	VCSr 61	54	-.14	-.16	-.11
	BF 61	28	.17	-.07	.15
	BM 61	37	.08	.21	-.16
Manifest Anxiety (MA)	VCFr 60A	53	.18	.17	.06
	VCFr 60B	50	-.29*	-.05	-.28*
	VCSr 60	38	#	#	#
	VCSr 61	54	-.25	-.40**	-.07
	BF 61	28	-.32	.34	-.39
	BM 61	37	-.31	.31	.11

* $p < .05$
** $p < .01$
\# VCSr 60 was not given the M.A. Scale

Table 18. Items which differentiate subjects who demand much information from those who demand little information before attempting solution to the problems. $p<.05$ for all items.

Item No.	More "True" responses from low information demanders.
10.	I have had periods of days, weeks, or months, when I couldn't take care of things because I couldn't "get going".
12.	I work under a great deal of tension.
74.	At times I have been so entertained by the cleverness of a crook that I have hoped he would get away with it.
81.	Sometimes without any reason or even when things are going wrong I feel excitedly happy, "on top of the world."
139.	I have had periods in which I lost sleep over worry.
153.	I like men who antagonize me somewhat.
165.	I easily become impatient with people.
183.	I sometimes keep on at a thing until others lose their patience with me.
	More "True" responses from high information demanders.
1.	I always see to it that my work is carefully planned and organized.
25.	I am very careful about my manner of dress.
61.	I have very few quarrels with members of my family.
116.	I am happy most of the time.

Table 19. Items which differentiate subjects who are extremely successful from those who are extremely unsuccessful in solving problems, regardless of Information Demand. $p<.05$ for all items.

	More "True" responses from extremely successful subjects.
129.	The only meaning to his existence is the one man gives himself.
	More "True" responses from extremely unsuccessful subjects.
88.	I have been afraid of things or people that I knew could not hurt me.
75.	It makes me nervous to have to wait.

Table 20. Items which differentiate high and low Success subjects within the low Information Demand group. Items in upper part $p < .05$. Items in lower part $p > .05, < .10$.

More "True" responses among highly successful subjects.

13. In illegitimate pregnancies abortion is in many cases the most reasonable alternative.
29. My hands and feet are usually warm enough.
141. I have very few fears compared to my friends.

More "True" responses among unsuccessful subjects.

86. I shrink from facing a crisis or difficulty.
88. I have been afraid of things or people that I knew could not hurt me.
103. I have never done anything dangerous for the thrill of it.
167. Sometimes when embarrassed I break out in a sweat which annoys me greatly.

Table 21. Items which differentiate high Success from low Success subjects within the high Information Demand group. $p < .05$ for all items.

More "True" responses among highly successful subjects

28. It is a good rule to accept nothing as certain or proved.
34. People who seem unsure and uncertain about things make me feel uncomfortable.
110. Sometimes I feel like smashing things.
129. The only meaning to his existence is the one man gives himself.

More "True" responses among unsuccessful subjects.

11. I would rather be a steady and dependable worker than a brilliant but unstable one.
27. I would disapprove of anyone's drinking to the point of intoxication at a party.
75. It makes me nervous to have to wait.
128. The unfinished and the imperfect often have greater appeal for me than the completed and polished.
173. I am more sensitive than most other people.

Table 22. Summary of quantitative differences in the interview findings. The differences are discussed in the text.*

Question	Content	Group 1	Group 2	Group 3	Group 4
1	Reaction to test				
	positive	86%	38%	50%	(14%)
	negative	0%	0%	0%	50%
2	Interests				
	people	71%	(23%)	43%	64%
	reading	71%	38%	43%	43%
	art	29%	31%	64%	36%
	music	71%	38%	43%	43%
	sports	71%	31%	43%	57%
	Creative participation	86%	(38%)	57%	50%
3	Significant change reported	56%	15%	21%	57%
4	Consuming passion reported	56%	31%	50%	43%
5	Risk taking				
	enjoyed	100%	62%	36%	36%
	ambiguous	0%	0%	21%	50%
	disliked	0%	38%	43%	14%
6	Significant influence felt	70%	50%	(14%)	36%

* Any pair of groups underlined are significantly higher than the other pair; any single group underlined is significantly higher than the others combined; any single group parenthesized is significantly lower than the others combined. Entries are percent of group responding as indicated. For all differences indicated, $p < .05$.

Table 23. Proportions of each group checking various adjectives as applying to them.*

	Low Information		High Information			
	High Success	Low Success	High Success	Low Success	P<	
Group No.	1	2	3	4		
Alert	100%	85%	64%	64%	.05	
Demanding	43%	31%[a]	29%	(00%)[b]	.02[a]	.01[b]
Sharpwitted	29%	38%[a]	21%	(00%)[b]	.05[a]	.10[b]
Quick	57%	46%	21%	07%	.01	
Anxious	00%	08%	36%	36%	.07	
Cautious	43%	54%	71%	64%	.10	
Kind	43%	38%	79%	71%	.01	
Modest	29%	31%	79%	57%	.02	
Confident	71%	38%	57%	21%	.05	
Foresighted	57%	15%	57%	29%	.05	
Informal	71%	38%	71%	43%	.05	
Resourceful	57%	38%	64%	21%	.01	
Spontaneous	71%	38%	64%	29%	.05	
Independent	86%	62%	57%	43%	.07	
Cynical	14%	46%[a]	29%	(00%)[b]	.05[a]	.01[b]
Headstrong	14%	46%[a]	29%	(00%)[b]	.05[a]	.01[b]
Conscientious	86%	(38%)	79%	79%	.01	
Self-Confident	57%	38%	43%	(14%)	.05	

* Underlining of a pair indicates that it is significantly higher than the other pair; underlining of a single group indicates that it is significantly higher than all others combined; parenthesizing a single group indicates that it is significantly lower than the other combined. Confidence levels are indicated in the right-hand column.